COMPRESSED AIR

A MONTHLY MAGAZINE DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. XI | JUNE, 1906 | No. 4

Published by THE KOBBÉ CO., 90-92 West Broadway, New York

Alphabetical Index of Advertisers, Page 5, Advertising Section.

COMPRESSED AIR

Established 1896.

A monthly magazine devoted to the useful applications of compressed air.

JUNE, 1906.

THE COMPARATIVE MERITS OF AIR AND ELECTRIC DRILLS

Written for COMPRESSED AIR

By

Granville E. Palmer

Invention has probably never won fewer and poorer rewards, in proportion to the talent expended, than those received by the designers of Electric Drills; and as the progress of the art during the past twenty years is analyzed, it seems to the writer that the difficulties presented to the designers of this form of apparatus are insurmountable.

The Air Drill seems to occupy a very secure position with regard to its retention as a standard form of apparatus; and it is quite remarkable that as a labor-saving device one of the most inefficient pieces of apparatus ever designed should have proved the most economical in its particular field.

Drilling holes in rock is an operation in which an exhibition of bull strength and awkwardness is desirable, and this feature the air drill seems to possess to a commercially marketable degree, to the exclusion of all other types of power drills. A jarring hammer blow, transmitted to a cutting edge, is the way of all ways for putting in rock holes of moderate depth; and for this class of work, tools driven directly by air or steam are practically ideal, as all of the parts of the reciprocative piston that are liable to damage are easily protected from mechanical injury, and so enclosed in a chamber of elastic and compressible gas that no damage results to them, even when the drill is instantly stopped by sticking in the hole—a not infrequent occurrence. Of course the electric drill, with its short, rapid stroke, cuts a cleaner and straighter hole than the air drill; but it does stick and stop short, with damaging results.

The particular advantages claimed for the electric over the air are low first cost of plant, ease of installation, and great economy of power,—and every one of these claims are true; but when the high cost of maintenance and time lost incident to break-downs are considered, the above claims sink into insignificance—particularly when the continuous operation of the entire mine depends more upon the reliability of the rock-drilling apparatus than on perhaps any other operation.

The reasons that the air and steam drills are a success, as above noted, are that the essential delicate parts are protected from jar, and that no injury to the apparatus occurs when the drill is stopped by a "sticky hole." The reason why the electric drill has proved a failure is because it is impossible to properly protect the motor from jar, and at the same time properly transmit and transform its rotary motion to the reciprocatory stroke necessary to operate the drill steel.

No form of insulation has yet been devised that will stand up under the continued jar of the drill body for any appreciable length of time; and though the results of experimental work have led several designers to believe that they had found a satisfactory form of insulation, the most successful types of apparatus have the drill proper connected with its motor by a flexible or semi-flexible shaft.

With the motor removed from the drill body, the insulation difficulties are overcome, and the transmission of the power from the revolving armature to the reciprocating draw bar, and from it to the chuck and ratchet bar is the last point to consider. As the travel of the draw bar, driven by a crank shaft and internal cam, must have definite limits of motion, and as the connection between the draw and chuck bars must be sufficiently flexible to permit the draw bar's continued operation when the chuck bar is held stationary by reason of the drill sticking in the hole, and at the same time be sufficiently rigid to permit of the chuck bar striking a blow representing a hundred or more foot pounds of energy under normal conditions, an exceedingly efficient spring transmission is necessary. Though wonderful things have been accomplished in spring manufacture, it does not seem that the art has reached the stage where the above results can be obtained in regular practice.

The usual reason for the installation of power drills in place of hand steel is to permit

of a more rapid advance in this branch of the work, so that it may keep step with other operations, and the use of apparatus that does not accomplish this result—even though it does perform the operation of drilling holes with somewhat greater economy—is a step backward. I think that the following table, compiled from a recent comparative test between two Adams Electric Drills (which certainly are equal, if not superior to any other electric drills on the market) and two old 2¾" Air Drills, operating at eighty pounds pressure at sea level, shows conclusively that the value of electric apparatus for work of this character is questionable.

Work done on black diabase about 7½° during fifty-three consecutive ten-hour shifts.

	Air Drill	Elec. Drill
Actual hours drilling....	317	100
Actual feet drilled......	1,279	253
Average feet per hour..	4	2.55
Times stopped for repairs	0	17

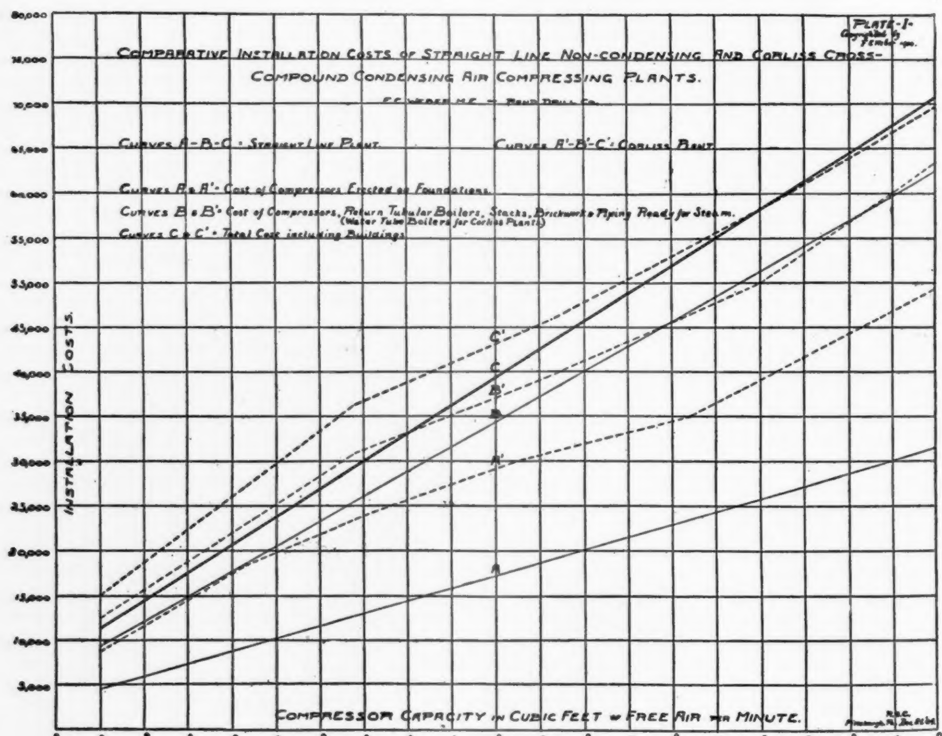
ECONOMY IN THE OPERATION OF COAL MINE POWER PLANTS

BY F. C. WEBER, M. E.

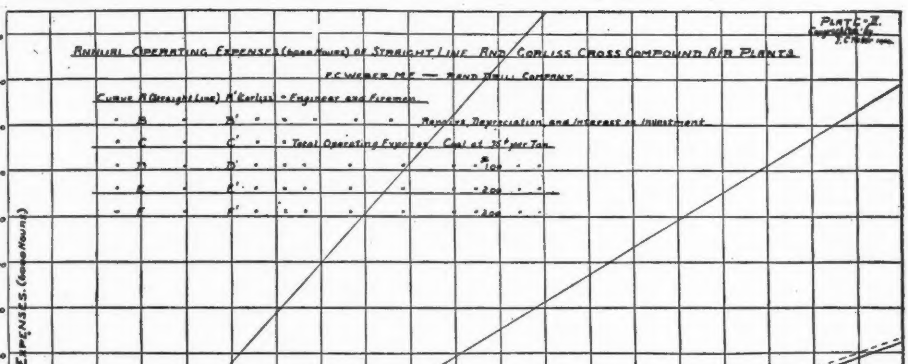
The advantages of the Corliss type of steam-engine over that of any other type of slow speed engine have been universally recognized by the engineering world for many years, and when used as the "power end" of an air compressor it is generally recognized that this combination produces the highest type of air compressor. This is especially true of the larger sizes of compressors.

This fact has long been taken advantage of in the mining districts of South Africa, Michigan, and many others, where fuel cost is an important item. Many of the mines at first acquired a number of small compressors to supply their different operations, which they replaced with larger Corliss compressors, as the total capacity warranted such a change. In many new mines to-day Corliss compressors are the only type considered from the start.

The more prominent coal mines are now beginning to place the proper value on this type of compressor, for the oldtime heresy that



ITEMS. CONDENSER.	STRAIGHT LINE COMPRESSOR PLANT. (Full Lines)—————— NON-CONDENSING.	CORLISS COMPRESSOR PLANT. (Dotted Lines)........... CONDENSING.
Air pressure at receiver, pounds per square inch.	100 pounds	100 pounds.
Steam pressure	100 pounds	125-135 pounds.
Type of steam-engine.........	Single cylinder	Cross-compound cylinders.
Type of steam valve gear.....	Meyer Valve Gear	Corliss Valve Gear.
Type of air compressor......	Single stage	Two stage.
Water rate, steam-engine.....	35 lbs. per I. H. P. per hour..	15 lbs. per I. H. P. per hour.
I. H. P. per 100 cu. ft. free air	20½ I. H. P.................	17¼ I. H. P.
Type of boiler...............	Return tubular	Water tube.
Type of buildings............	Wood structure	Wood and structural steel.
Foundations and piers........	Concrete	Concrete.
Interest on investment.......	4 per cent.	4 per cent.
Depreciation and repairs......	8 per cent.	6 per cent.
No. hours per year considered	6,000 hours	6,000 hours.
Cost of coal at boilers........	75c. to $1.00 per ton	75c. to $1.00 per ton.
Compressor capacity in free air per minute................	1,500 to 11,000 cu. ft..........	1,500 to 11,000 cu. ft.



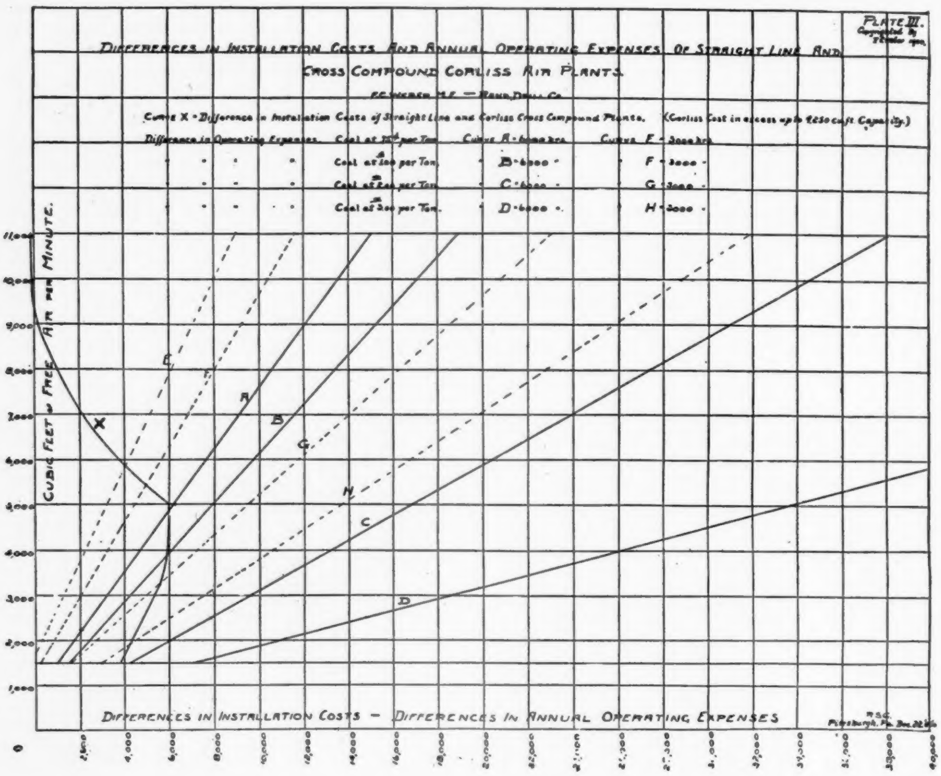
"fuel costs nothing and need not be considered" is rapidly giving way to the more logical view that any waste is a positive loss and what does the work for one ought to it for some one else, and thereby yield its profits to the producer.

If one mining plant requires from 100 to 150 per cent. more coal than another for a given amount of power, the mine is certainly sacrificing its profit on the *extra* fuel burned, for the coal makes just as good steam under the customer's boilers. Again, if two to two and one half times as much coal is burned for a given amount of power, it costs the mine $1.50 to $2.00, plus selling profit on the fuel burned, for what they could obtain in the more economical type of plant at 75 cents, which is about the average cost per ton to the mine for coal burned under their boilers. Then again, the less economical type of engine requires a larger boiler plant to burn the extra coal to keep up the steam, which means more

firemen and more repairs and more trouble with bad water. When this comparison is between the ordinary straight line type of compressor, commonly used by most coal mines, and a cross-compound Corliss condensing two-stage air compressor, the relative difference in economy is quite marked, even for machines of moderate capacities; and to show the relation of these two types of compressor plants to each other as regards *complete* installation costs and operating expenses, the accompanying diagrams were prepared.

in general practice and are as shown in table on the following page.

From a study of the results it is apparent that the Corliss compressor has a legitimate field in the coal mine, for even with capacities as low as 2,500 cubic feet, the difference of cost in installation is made up in two years. At 5,000 cubic feet capacity the difference is made up in one year with coal at 75 cents per ton. Beyond this point there is absolutely no question about the economy of the Corliss type of compressor, for the difference in installation



As shown in Plates I and II, the free air capacity of the two types of compressors is compared with installation costs and operating expenses for sizes from 1,500 to 11,000 cubic feet per minute. The installation costs are close approximations to actual costs, and would meet general conditions under which such plants are installed in different parts of the country. The difference in first cost and operating expenses between the two types is shown in Plate III.

The operating expenses are based on 6,000 hours' work per year, and the price of coal is taken at 75 cents, $1.00, $2.00 and $3.00 per ton. The last two costs are intended for mines other than coal mines. The conditions assumed in these calculations are such as obtain

costs is a decreasing one, and at 9,500 cubic feet capacity the installation cost of the Corliss plant is less than that of the straight-line compressor plant.

The straight-line plants tabulated here have been favored in many respects, for both types of plants are considered as placed under one roof, whereas the average straight-line plant of four to six machines has at least three to four buildings and separate engineers and firemen.

Aside from its economic advantages, the Corliss compressor possesses mechanical advantages over the other type, that recommend it. It has a higher mechanical efficiency, or less friction, its volumetric efficiency is higher, the lubrication is better, the maximum strains

are lower, resistance is more uniform, and its life is longer. The regulation is automatic and is effected through the governor on the cut-off mechanism of the valve gear.

It is generally possible to place the power plant near a stream, so that condensing water can be used; if the stream is not a large one, provision for damming the water can be made at comparatively low cost, so that the condensing water can be used over and over.

As to the advisability of replacing existing line plants with a Corliss plant, the present value of the old plant deducted from that of a new Corliss plant will represent an investment that can yield ample returns through coal saved, such as easily to warrant the change. The boilers need not be changed for better types until worn out.

MODERN METHODS OF ROCK EXCAVATION

Well Drilling Machines Operated by Compressed Air on Heavy Contract Work

In the November issue of COMPRESSED AIR there appeared an article entitled, "A Central Compressed Air Power Plant for Heavy Railroad Construction," by Lucius I. Wightman, E. E. This article described in detail the compressed air installation for work on the low grade freight line of the Pennsylvania Railroad near Safe Harbor, Pa. It is the intention of the present article to describe the work accomplished by the well-drilling machines on this contract more fully than was done in the previous article.

There were forty-two such machines in use and the results attained were so remarkable that we believe they warrant special mention. It will be remembered by those who read the previous article that the plans involved a double track line at a height above the river which would avoid all difficulty from high water; and its object was to remove the congestion of freight traffic on the main line, as well as to reduce the heavy freight hauls which marked this section of the road. Probably, the most difficult conditions were met at a section about nine miles in length beginning on the north, near Columbia, Pa., and reaching to Modic Fords, upon the south. Along this stretch the hills jut into the river with abrupt headlands of solid rock several hundred feet high and, in many cases, almost perpendicular.

The work here consisted of a continuous cut in solid rock and the almost vertical hill-side made necessary the removal of vast quantities of rock with tremendous charges of powder, before the necessary width could be secured at grade. This section is especially interesting and noteworthy in that practically all the rock was removed by heavy blasts, the holes for which were drilled by portable well-drilling machines, operating under compressed air supplied from the central compressed air power plant.

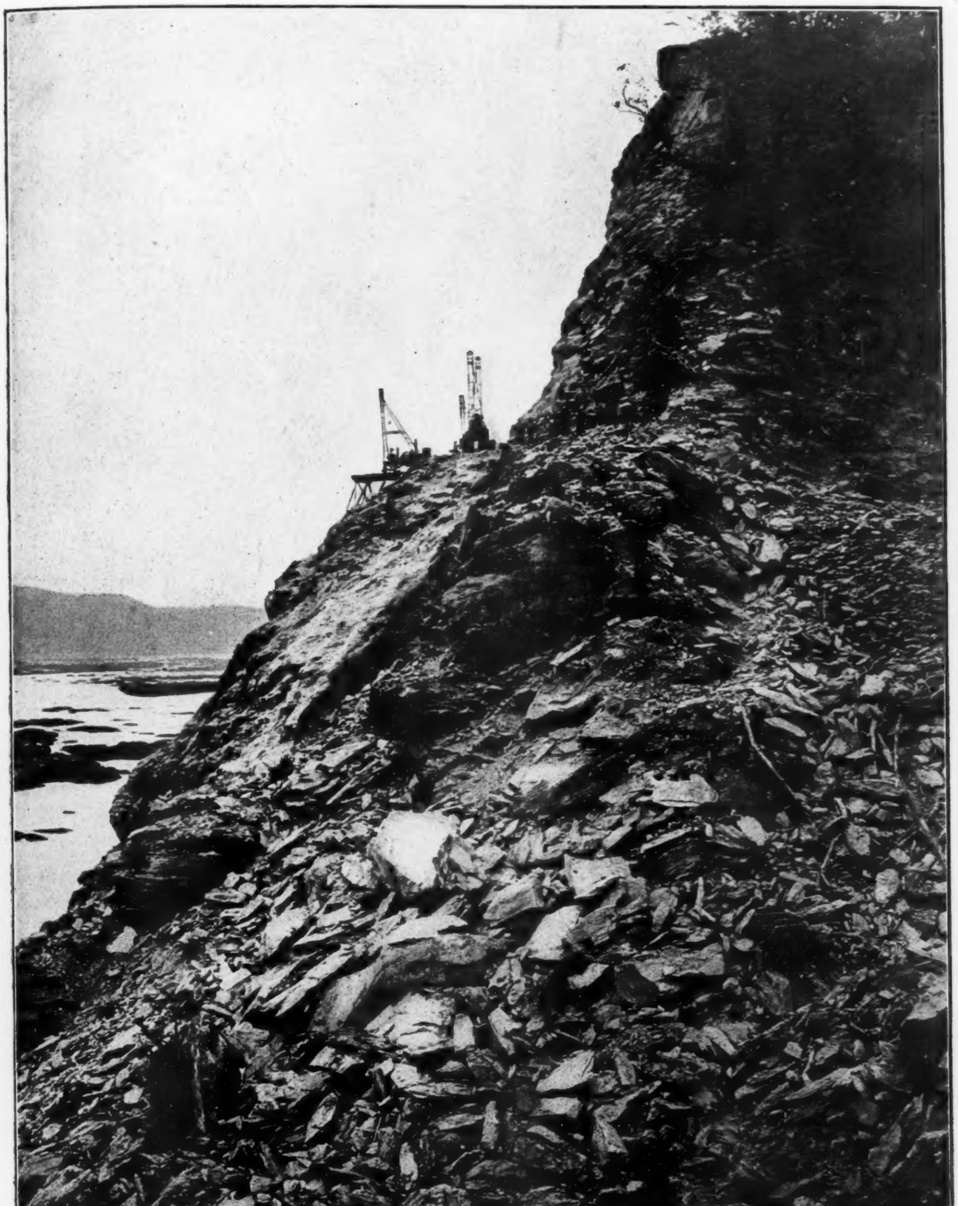
The contractor for this work was H. S. Kerbaugh, Inc., of Philadelphia, who employed forty-two well-drilling machines on this contract, and to whom we are indebted for much of the data contained in this article.

Before describing the operation of these machines in connection with this contract, however, it might be well to state briefly the reasons which led to the selection of these machines for such important work. The above named company had previously undertaken the construction of the Enola Yards for the Pennsylvania Railroad Company. They had three hundred to four hundred laborers drilling holes by hand, using churn drills and drilling to a depth of from twenty to thirty feet. The material drilled was shale and could not be drilled by rock drills. At that time they had ten steam shovels and contemplated adding that many more and working them day and night. The large increase in labor expense and the prospect that even an increase in the laborers would not keep the material loosened up in order that the shovels might dig uninterruptedly, forced them to adopt some better method of drilling. The cutting averaged seventy-five feet deep and it was therefore necessary, with churn drills, to make three lifts, requiring switchbacks and grades of 2 per cent. to get the material from the shovels to the fills. Well drills were adopted and the cuts were made at grade, doing away with the switch-backs and the 2 per cent. grades. The machines adopted had a drilling capacity of 250 to 400 feet for four and a half to six-inch holes, were fitted with 5 to 6 H. P. reversing engines, and were manufactured by the Star Drilling Machine Company, of Akron, Ohio. With seventeen of these drills, single shifted, it was not only possible to keep twenty-two steam shovels working, but it was possible to keep holes drilled ahead. On the Enola Yard

work all the well drills were steam actuated. The holes averaged seventy-five feet deep, five and five-eighths inches in diameter and a drill averaged forty-eight feet of hole drilled per ten-hour shift. In some cases the drills averaged eighty feet per ten hours and in other cases less than twenty feet, this latter being due to caving in of the material and it was sometimes due to the presence of limestone, flint or quartz in the last fifteen feet of the deep drilling.

After such a practical demonstration as this of the advantages to be obtained by the use of well-drilling machines it was natural that H. S. Kerbaugh, Inc., should adopt them in connection with the work at Safe Harbor, although it was an entirely different proposition from the Enola work. The ground to be drilled was hard rock of a gneiss mica schist formation with a small percentage of lime. This rock varied in hardness and the seams were at varying angles to the perpendicular, causing the drills to deflect and adding greatly to the difficulties. In crossing these seams and in straightening up the holes X-bits were used. The first ten to forty feet in some places required casing, but in other places the holes started with the solid rock. The holes were five and five-eighths inches in diameter all the way down and ranged in depth from one hundred to one hundred and thirty feet. The average drilling was nineteen feet six inches per ten-hour shift, but the rate varied greatly, according to the location. On the west end of the work, the rate was sixty feet in ten hours, while at Mann's Run, where the holes were from seventy-five to one hundred and twenty-eight feet deep, the rate was eleven feet per day. At Star Rock one hundred-foot holes averaged fourteen feet per ten hours. At Buzzard Rock, where holes were from one hundred to one hundred and thirty feet deep, the average was nine feet per ten hours. From the Buzzard Rock to Brenner's Hollow, in

BLAST-HOLE DRILLERS OPERATING ON SIDE HILL WORK.



SHOWING THE DIFFICULT NATURE OF THE WORK.

nine thousand feet of solid rock drilling, the holes averaged from sixty feet to one hundred and thirty feet in depth, the rate of drilling being nine feet per ten-hour shift. From Brenner's Hollow to Safe Harbor Viaduct the drilling was from eighty feet to one hundred and thirty feet deep; the average rate being twenty feet per ten hours. The drills on the Safe Harbor work for the first sixty days were steam actuated, and after that time were driven by compressed air, the size of the contract making it advisable to operate as far as

ONE OF THE BLASTS.

possible all machines from a central compressed air power plant, thus affecting considerable saving over the cost of operating numerous temporary boilers scattered throughout the course of the work.

The method of excavation has been that of drilling a number of very deep vertical holes along the inside of the desired cut, and a series of "snake" holes of a suitable depth on a level with the bottom of the vertical holes. These holes were sprung by a charge of dynamite, then loaded with blasting powder and the entire series discharged at once by an electric current from the central power plant. Enormous charges were used and great quantities of rock dislodged. In many instances the major part of the mass was thrown into the river and required no handling, the last rock remaining was loaded in cars by chain shovels and run back over a light railroad to suitable dumping places, but fills were remarkably infrequent.

In carrying out this work the drilling machines were properly located and a branch pipe from the air main connected by a length of hose to the boiler, which thus served as a secondary receiver. No changes were made necessary in the machine itself by the use of compressed air in place of steam for the motive power, the machines working equally well on either. It was found, however, that they did not work effectively with less than eighty pounds pressure. When steam driven they required one driller and two helpers. When air driven, one driller and one helper.

Owing to the difficult positions in which these drills were placed, four men were required for every two drills to carry the bits to the blacksmith shop. In some places horses were used to drag the bits to the shops, while on one section it was necessary to use a horse, and rope and pulley to hoist the bits to a road one hundred and twenty-five feet above the drilling stage to get them to a shop.

All the work in connection with this contract was side hill work. It was, therefore, necessary, in order to place the well-drills on the face of the cliffs, to make roads ten feet wide by hand labor, using in some places rock drills, drilling holes ten to thirty feet in depth. The drilling machines were then propelled along these roads, drilling holes to the required depth. In some cases drills were erected at right angles to these roads in order that a machine could drill holes in projecting points.

The question may arise in the minds of some readers as to how it could be economical to use machines which had to have a special roadway constructed for them along the sides of the cliffs. The answer to this is that the element of economy did not enter into the actual drilling. It was found in the greater efficiency in blasting; more rock being displaced by blasting well-drilled holes, drilled below grade, than by successive lifts of from twenty-five to thirty feet, using rock drills to drill the holes. Rock drill holes were drilled very rapidly but were less efficient when blasted, each bench having to be cleaned off by hand labor except the final one at grade, which was cleaned off by using a steam shovel. The well-drilled holes, once drilled below grade, did the work so well that whatever material was left on the bench could be removed by steam shovels, thus doing away entirely with hand labor.

The horizontal or "snake" holes were drilled by standard rock drills, about two hundred and fifty of these machines, having been used on the work. The holes drilled averaged in depth up to a maximum of thirty-five feet. The deepest holes were four and a half inches in diameter at the top and diminished to one and five-eighths inches at the bottom. As the rock varied considerably in character, the average being of a hardness rather above the ordinary, the service was not easy on the machines and the average of each drill was from forty to sixty feet of hole per day, including the necessary delays due to changing steels and moving positions.

COMPRESSING AIR HYDRAULICALLY

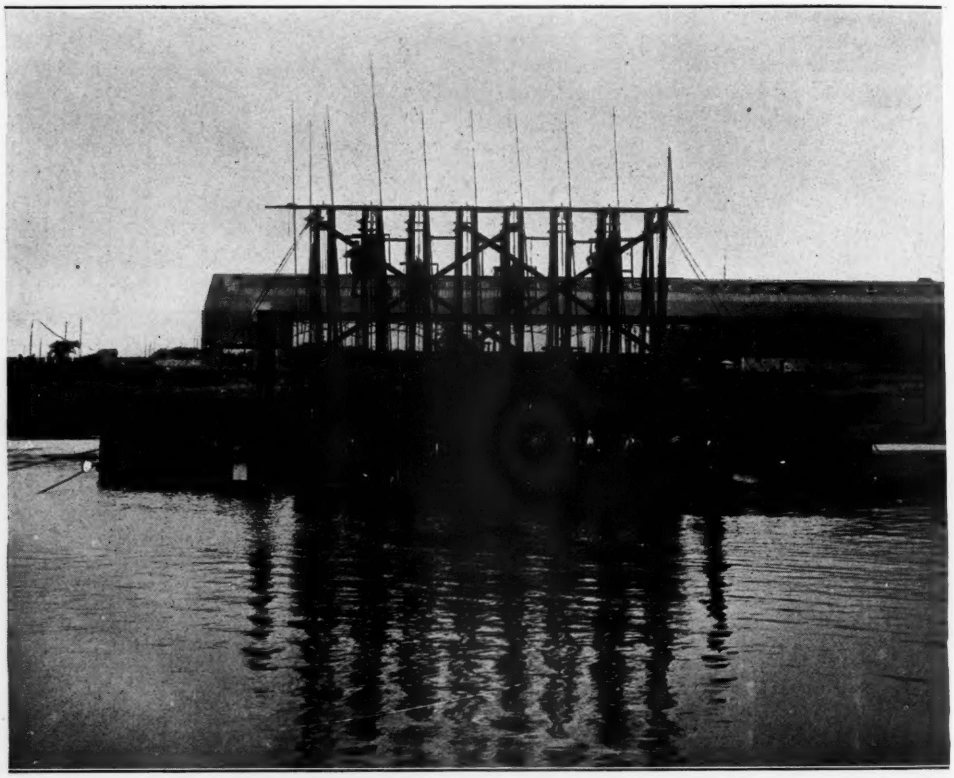
The utilization of water power for the compression of air by entrainment is becoming increasingly frequent. Such a plant has been in operation at Magog, Canada, for some time, a 1,500 h. p. plant has just been put in operation at the junction of the Quinebaug and Shetucket rivers in Connecticut, where it replaces steam in forty engines in neighboring manufacturing plants. A 4,500 h. p. plant is now being completed in Rockland, Mich., to furnish power for the entire operation of the Victoria mine. A highly interesting description of the Quinebaug plant was read in the March meeting of the New England Water Works Association by J. H. Shedd, consulting engineer for the project.

SUBMARINE DRILLING IN THE CLYDE NEAR GLASGOW

By
E. F. Schaefer, M. M. E.

The conditions under which submarine rock excavation must be done are extremely difficult, calling for special apparatus of unusual strength and endurance. This character of work is nearly always carried on where tides, currents, winds and storms are present in varying degrees, and these elements are antagonistic to economical and rapid work, and until recently involved such uncertainty as to require absolute daring to undertake river and harbor excavation; but, add to these troubles, deep water, irregular bottom, covered with mud, sand or other shifting material which fills in almost as fast as removed, and a combination of difficulties results which was, up to the present time, almost insurmountable.

Owing to the increasing submergence of both ocean and lake-going vessels the removal of subaqueos is daily becoming a more important feature. The deepening of channels is possible only because of the improvements which have been made in rock drills, and today such work may be done effectively, rapidly and cheaply. In modern submarine drilling, steels are used anywhere from 30 to 60 feet in length and sometimes they weigh as much as 400 pounds. To drill with such steel in hard homogeneous material is a problem. In poor material and under water, where the drill



SUBMARINE DRILLING IN THE CLYDE.

must be run by the sense of feeling, difficulties are multiplied as it is absolutely essential to have a drill which is at once massive, powerful, durable, and capable of perfect control through all ranges of length of stroke and weight of blow. The drill must, of course, be mounted on a barge, scow or float, fitted with suitable framing to support the drill guides, the drills, the boilers and other auxiliary apparatus. The barge is towed into place and anchored by means of cables, anchor chains or spuds, or a combination of these

methods, depending upon the rise and fall of the tides or the currents to be encountered.

In the photograph reproduced in these pages is shown one of the two barges which are, at present, working on the Elderslie Rock Blasting Contract at Renfrew, near Glasgow. The contractors for this work are Messrs. Hill & Co., of Plymouth and London.

The work to be accomplished is of a very extensive nature and consists in drilling, blasting and removing rock for deepening the channel in the Clyde. Many thousands of holes must be drilled, the average depth of each being about eight feet. Occasionally, however, the bed of the river is such that a depth of ten feet is necessary and this drilling must be accomplished through a maximum depth of water of thirty feet.

Each barge is provided with eight Ingersoll Rand Class HA-1 Rock Drills. This drill has a diameter of five inches and a length of stroke of eight inches.

The drills take steam from two boilers on either end of the barge, these being of the Marine Type, working under 120 pounds pressure. They are connected to a main steam pipe which runs behind the drills, and from which branch pipes, fitted with stop valves, are taken. The drills are connected with these branch pipes by means of steam hose. Immediately below the stop valves are hand winches which are used to feed the drills to the work or to raise them from it. The drills are supported in guides and suspended by wire ropes which pass over pulleys at the top of the frame and under pulleys at the bottom, thus allowing a very accurate feeding of the machines. Behind these winches is a secondary and smaller winch provided with a wire rope to hoist the drill steels from the holes and replace them preparatory to drilling. The winches and the handles of the stop valves are in close proximity so that one man can handle each machine.

Submarine tubes which are used in this contract consist in each case, of long lengths of four-inch screwed piping which may be extended to meet the rise of the tide. These tubes are forced through the over-lying mud, sand or gravel, to the rock-bed and serve to keep the advancing hole free from extraneous matter. The holes are drilled exactly as in the case of drilling down holes on land, the drill being fed down as far as possible, then being run back, a longer steel inserted, and so on, until the desired depth is reached, when the steel is removed and the hole charged with explosive through the tube. The casing tube is then removed, the wires connected with the blasting battery and explosion effected without shifting the barge.

A further feature of the plant is the cages situated at either side of the drills, permitting any adjustment to be made while the machines are in operation. From the time of starting the first drill to finishing the set of eight holes, the average time consumed is from two, to two and a half hours. This work is so extensive in character that up to the present time nearly two years have been devoted to it, and before its completion there is a possibility of operations being continued for another year. The drills have satisfactorily met all the difficult conditions encountered in this subaqueous excavation and are being employed with perfect success in the operations on the Clyde. In practically every submarine undertaking of any importance, embracing the pioneer work in New York Harbor, dozens of United States Governmental undertakings, in the Iron Gates of the Danube and Prussia, Portsmouth, England, Panama Canal, Havana Harbor, Cuba, Boston, and many great works in the Great Lakes and other undertakings, both Governmental and private, in all parts of the world, these rock drills have been used, and thus is added to the already long list another undertaking of considerable importance.

COMPRESSED AIR IN THE LONG ISLAND CITY POWER STATION

The Pennsylvania, New York & Long Island Railroad Co. have just completed a large power house at Long Island City, in which compressed air has been installed very extensively for cleaning and other purposes. Air is supplied by two Westinghouse motor-driven compressors, operating on a 220 volt electric current. Each compressor has a capacity of 50 cu. ft. of free air per minute delivered at 100 lb. pressure, and is controlled automatically by a pump governor. The compressed air is used for cleaning the main and auxiliary generators, switchboard apparatus and electrical accessories, and also in connection with the oiling system for forcing new cylinder oil and new crank case oil into the storage tanks from which these oils are delivered to the oiling system. It is also used for an air hoist for handling oil barrels and emptying them into the receiving tanks. The pressure usually carried on this system is 80 lb. gage.

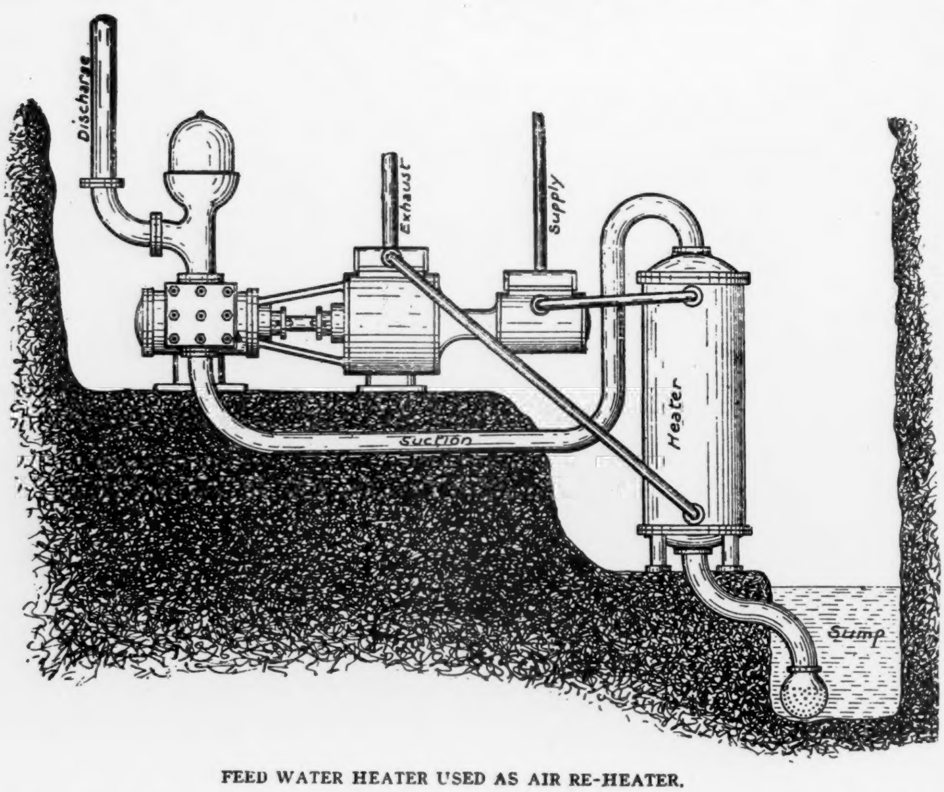
COMPRESSED AIR PUMP WITH WATER-HEATED REHEATER.*

BY L. C. BAYLES.

A simple and economical improvement was made at the Gwen mine, Calaveras county, California. It was necessary to lift 200 gal. of water per minute to a height of 600 ft. At first this water was raised with a direct-acting sinking pump. The compressed air was furnished by a separate compressor which only supplied this pump and a hoist. It was found that when the pump was shut down the compressor was obliged to make 20 r.p.m. to operate the hoist and overcome pipe leakage.

With the pump in operation the speed of the compressor was 55 r.p.m., establishing the fact that the pump consumed the air compressed by 35 r.p.m. of the compressor. It was not considered advisable to install a re-heater of any of the standard types, but the engineer devised a simple method of obtaining practically as good results without the costs involved in firing a re-heater.

The sinking pump was discarded and a direct-acting compound pump was installed in its place, along with a Wainwright feed-water heater. This feed-water heater was placed in the suction pipe of the pump, so that all the water passed through it before reaching the pump. The supply of compressed air was first led into the high-pressure cylinder, where it did a certain amount of work, and then passed into the shell of the heater at about 35 lb. pressure. Having been allowed to perform a certain amount of expansive work in the high-pressure cylinder, the temperature of the air entering the feed-water heater was reduced to a low point—in fact, the temperature of this air was below freezing point. As the air passed through the feed-water heater, its temperature was brought up to that of the water, which was about 70 deg. The air then entered the low-pressure cylinder, where it again performed some expansive work before escaping into the atmosphere. The slight fall in the temperature of the water being pumped was of no account. It was found that when this pump was put at work, the compressor was able to supply both the hoist and the pump when making only 35 r.p.m. In other words, the single-cylinder pump used 130 per cent. more air than the compound pump and the feed-water heater.



FEED WATER HEATER USED AS AIR RE-HEATER.

The amount of compressed air required

*From the Engineering and Mining Journal.

could have been still further reduced if a pump of the fly-wheel type had been especially designed for this case, with water-jacketed cylinders and discharge pipes, in which case the expansion could have been carried much further without danger of freezing. It goes without saying that the installation of a heater, which would have brought the temperature of the air up to 350 deg. before it entered either cylinder, would have reduced the amount of air the compressor had to supply for this pump

to one-third of the quantity required for the single-cylinder pump using cold air. The cost of installing a pump and heater, such as just described, would not exceed the cost of a single-cylinder pump by more than about 50 per cent., which difference would be more than saved in the first two months.

I believe that, while not showing anything like as high efficiency in test runs as where reheaters are used, which bring the temperature up to between 300 and 400 deg., this method of using compressed air will be found the most satisfactory for general underground pumping, especially in cases where small pumps are required, and that it is efficient enough to make compressed air the most desirable motive power for the majority of underground pumps.

CLEANING THE HIPPRODROME BY VACUUM PROCESS

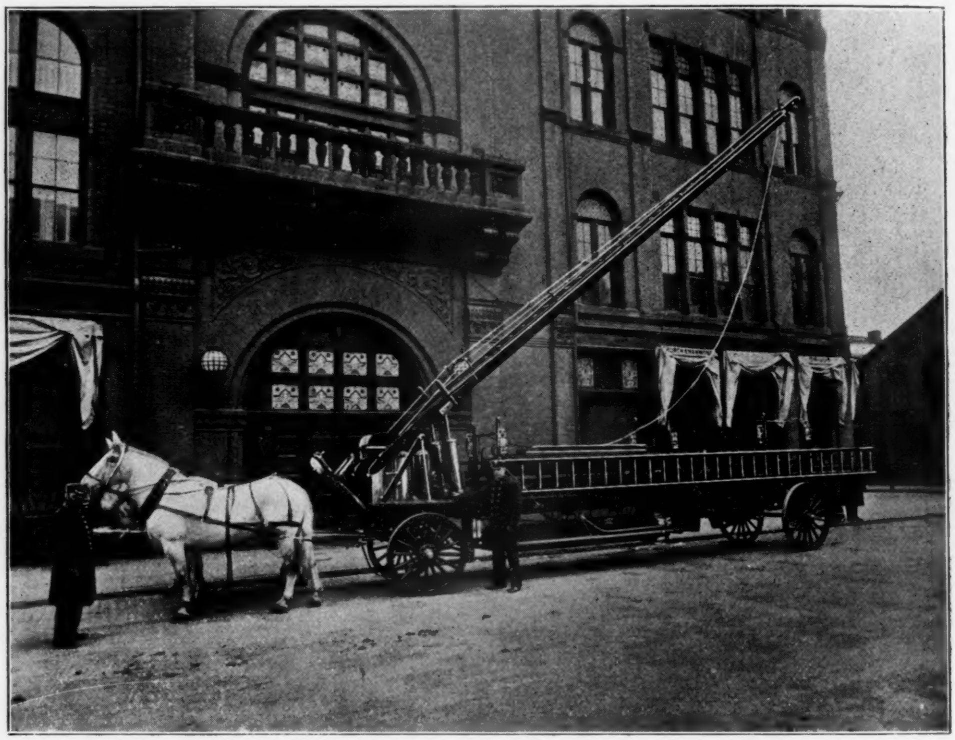
The accompanying illustration shows the wagons of the Vacuum Cleaner Company upon the stage of the New York Hippidrome. This great playhouse is cleaned at regular intervals by the vacuum system, which is probably the most sanitary method of extracting dust from carpets, cushions, floors, walls, etc., without disseminating it in the air. The Hippodrome, however, is not the only theatre which has adopted this method of cleaning, as many of the leading theatres in New York City and elsewhere throughout the country have either installed a permanent plant of the vacuum type or else use the portable wagon system at regular intervals. The vacuum system is controlled by the Vacuum Cleaner Co., of New York, who have established branch offices in many of the large cities of the country.

HOOK AND LADDER OPERATED BY COMPRESSED AIR.

There has recently been tested in New Bedford, Mass., a compressed air device for raising ladders on hook and ladder trucks.

The illustration shows the general appearance of this device, which consists of two brass cylinders mounted vertically upon the turntable of the hook and ladder truck. Pistons, operating in these cylinders, are connected by rods to the side bars of the ladder. Air is stored in a tank under 300 lbs. pressure, and is passed through an intermediate compartment filled with non-freezing fluid before being led to the operating cylinders. An automatic cut-off valve shuts off the supply of air as soon as the ladder reaches a perpendicular position. The whole operation is under the control of one person who manipulates the throttle valve, by-pass and exhaust valves.

This device may be applied to almost any hook and ladder truck, but is especially adapted to the type known as the "Hayes" truck. It is said to be simple, safe and easy of operation, one man being able to raise the ladder from its bed to an upright position as fast as is consistent with safety; in fact, the ladder has been raised in five seconds, but it is not considered advisable to raise a ladder, 75 feet or over in height, in less than seven seconds. One charge of compressed air is sufficient to raise and lower the ladder at least ten times. The device is manufactured by the Pneumatic Aerial Appliance Co., of New Bedford, Mass.



AN ALIBI FOR AN AIR COMPRESSOR.

BY FRANK RICHARDS.

Two or three months ago, at a structural iron works at 136th street and Madison avenue, New York, there was an explosion in the night, followed by a fire which destroyed the entire building. As an explosion has occasionally occurred in connection with an air compressor, when driven hard without proper cooling arrangements, it was suggested that the compressor was the cause of the trouble in this case. A little investigation showed the absurdity of the charge and established a com-

plete alibi for the compressor. The compressor was not there at the time. That is, it was not there as a compressor, for it was not in operation. Besides that the part of the compressor which could by any possibility have exploded, the air cylinder, was entirely intact and uninjured.

The snap-shot half-tone tells the whole story. The compressor, which was a small one with an electric motor and a belt drive, was located near a wall, and between the wall and the compressor a charge of dynamite had been exploded, shattering practically every part of the compressor except the cylinder, which projected at the back of the machine and was out of the field of action. In the picture the air cylinder is in the left hand background, close under the air receiver, and the rim of one of the wheels leans against the wall. The base of the frame is shown still bolted to the timbers.

Dr. Walter T. Scheele, consulting chemist of Baltimore, has been granted a patent upon his process of preserving with liquid air. This is said to be the first patent ever granted in this country or abroad for the commercial appliance of liquid air.

A corporation will be formed to develop the patent and eight others now before the United States Commissioner. Mr. William J. Hooper, of Baltimore, is the promoter. Baltimore and New York capitalists are interested.

AN INDUSTRIAL COMPRESSED AIR RAILWAY.*

COMPRESSED AIR LOCOMOTIVES IN THE ANACONDA COPPER MINING COMPANY'S NEW REDUCTION WORKS AT ANACONDA, MONTANA, U. S. A.

In May, 1905, the writer became indebted to Mr. E. P. Matthewson, manager of the Anaconda Copper Mining Company's new reduction works, for opportunities offered to study their rather novel compressed air system of transportation. Compressed air locomotives are used at these works more extensively and continuously than at any other mine or works in the world. The Anaconda reduction works are operated twenty-four hours per day, and seven days in the week.

The company works eleven or twelve compressed air locomotives for sixteen hours each day, and nine for the remaining eight hours. It owns thirteen locomotives, as under the conditions practically continuous work is essential, and a spare locomotive is required in order that necessary repairs may be made. Twelve of these locomotives weigh 26,000 pounds each, have cylinders 9½ inches in diameter by 14-inch stroke; driving wheels 28 inches in diameter; a rigid wheelbase of 54 inches; main storage tanks of 132 cubic feet capacity; tractive force 5,700 pounds. The remaining loco-

*By C. B. Hodges, in Cassier's Magazine.

motive weighs 42,000 pounds, has cylinders 12 inches in diameter by 18 inches stroke; driving wheels 36 inches in diameter; a rigid wheel-base of 60 inches; main storage tanks of 218 cubic feet capacity; tractive force 9,180 pounds.

The main storage tanks are charged, at intervals of from twenty minutes to one hour, with air at a pressure of from 700 to 800 pounds per square inch, which is then reduced to a pressure of about 150 pounds for use in the cylinders of the locomotives. When the pressure in the main storage tanks, as shown by a gauge facing the engineer, has dropped to a point near 150 pounds per square inch, the locomotive is stopped at the next charging station and recharged, this operation of recharging taking from one to two minutes.

The machinery on these locomotives is in most respects the same as would be employed on a steam locomotive of the same size, the chief difference being that the cylinders are ribbed, in order that they may the more rapidly absorb heat from the atmosphere, instead of being lagged to prevent the loss of heat, as in the case with steam locomotives. The compressed air goes into the main storage tanks on the locomotives at atmospheric temperature, and falls to a temperature far below that of the atmosphere during the expansion in the cylinders. This feature has an important bearing upon the relative efficiencies of the three great powers—steam, electricity and compressed air, under certain conditions.

An electric motor is an inefficient machine while coming up to normal speed; a steam engine is inefficient until the walls of the cylinders are thoroughly heated; but a compressed air engine is most efficient, thermodynamically, with the first movement of the piston, because the walls of the cylinders are then at their highest temperature. This fact would point to the use of compressed air locomotives wherever stops and starts are to occur with great frequency. The main storage tanks on the air locomotives replace the boiler, and need but little description. They are exceptionally good pieces of work, having required no repairs during four years of service; they are to-day practically bottle-tight. The locomotives stand for hours without perceptible loss of pressure.

The regulating valves on the locomotives deserve special attention. To make the locomotives successful, this piece of apparatus must at all times maintain, with the minimum amount of attention, a practically uniform pressure in the small auxiliary reservoir located between the regulating valve and the throttle valve, and be absolutely tight when the locomotive is at rest. How well the regulating valves on these locomotives perform is evident to anyone who rides on them. The gauge-hand that indicates the pressure in the auxiliary reservoir is apparently glued to the 150-pound mark on the gauge while the locomotive is in motion, and it seldom rises above 175 pounds while the locomotive is at rest.

The compressed air required by the locomotives is furnished by two compressors, having cross-compound steam cylinders equipped with Corliss valve-gear, and four-stage air cylinders. The compressors are duplicates. The high-pressure steam cylinder is 20 inches, and the low-pressure steam cylinder, 40 inches in diameter; all air cylinders are single-acting; the intake air cylinder is 37¼ inches in diameter, first intermediate cylinder 20¼ inches, second intermediate cylinder 12½ inches, high-pressure cylinder 6 inches, and the common stroke is 48 inches. The intake and first intermediate cylinders are placed behind one steam cylinder; the second intermediate and high-pressure cylinders behind the other. All the air cylinders are water-jacketed, and intercoolers are provided for cooling the air after each stage of compression.

The compressors are equipped with automatic speed and pressure governors, and an examination of the sheets taken from the recording gauge shows that the regulation of pressure is absolutely perfect. They are operated with steam at 150 pounds pressure and with a vacuum of 17 inches in the condenser, perfect vacuum at the elevation being 24 inches. The rated speed is 70 revolutions per minute; the horse-power developed per revolution, 8.7; the steam consumption per horse-power-hour when operating at a speed of 55 revolutions per minute, 18.67 pounds. The company intends to improve the vacuum in the near future, which will undoubtedly result in a lower steam consumption.

The remainder of the haulage equipment consists of a system of piping varying in size from 2 to 6 inches. This serves two purposes: First, it connects the compressors with the various charging stations; second, it provides a reservoir containing a reserve supply of com-

pressed air at a pressure in excess of that required by the locomotives, and sufficient to charge one or two locomotives instantaneously. Although this pipe line sustains a pressure of 950 pounds per square inch and consists of several thousand feet of pipe of various sizes, with many branches, valves, and charging station connections, leaks are extremely rare and the locomotives, in doing their varied work, pass from the bottom of one building to the top of another, under the dripping bins from which the concentrates are drawn, and over, under and around the furnaces, in an atmosphere of heat, dust and sulphurous acid, with sharp curves, steep grades, and loads that tax their capacity to the extreme limit.

PERFORMANCE OF COMPRESSED AIR LOCOMOTIVES

Number of Locomotives	MATERIAL	Quantity in Net tons	Weight in Lbs. of Empty Car	Average W'ght in Lbs. of Load on each Car	Number of Cars per Train	Number of Trains per Shift	Number of Shifts Worked	Distance in Feet
1	Coarse concentrates, first-class ore, converter lining and lime rock	1200.	7,500	16,666	12	6	2	7,000
1	Fine concentrates	1746.54	6,400	18,192	6	10 or 11	3	2,000
1	Coal	360.	6,200	6,545	6 or 7	5 or 6	3	3,400
2	Calcines............	1450.	6,500	10,175	3	32	3	1,500
1	Hot metal..............................	731.42	23,200	19,505	1 or 2 seldom 3	13 to 15	3	1,800
3	Coarse concentrates, flue-dust, first-class ore, clay and lime rock	3600.	4,200	4,286	2 trains 16 cars 1 train 20 cars	53	3	1,600
1	Miscellaneous	1400.	32,000	53,000	1 or 2	13	3	1,000
1	Miscellaneous	950.	6,400	9,000	1 to 20	12	2	1,000
	Total	11,437.96						

	MATERIAL	Grade	From	To	See Note	Ton-Miles Exclusive of Locomotives Net	Gross
1	Course concentrates, first-class ore, converter lining and lime rock	2% F. L. *	Upper part concentrator	Stock bins	A	2,120	4,027
1	Fine concentrates....................	1% A. L. †	Lower part concentrator	Roaster building	..	662	1,127
1	Coal..................................	Level	Stock bins	Reverberatory furnaces	..	282	671
2	Calcines	Level	Roaster	Reverberatory furnaces	..	412	938
1	Hot metal.	Level	Reverberatory and blast furnaces	Converter	B	207	684
3	Coarse concentrates, flue dust, first-class ore, clay and lime rock	Level and 2½% A. L †	Stock bins and brick plant	Blast furnaces	C	1,090	3,225
1	Miscellaneous		Between all points		D	267	581
1	Miscellaneous		Between all points		D	140	340
	Total					5,170	11,593

NOTE A.—A 42,000-pound locomotive. This locomotive also shifts 5 or 6 standard railroad cars per day, and also one large wood car per day, equivalent to about 2 more round trips per shift.

NOTE B.—Each round trip includes trip through Y for cleaning ladle and three weighings.

NOTE C.—Each round trip includes side trips to various locations under stock bins and to brick plant, then to blast furnaces.

NOTE D.—Miscellaneous shifting of standard railroad cars and plant cars, handled by both locomotives. This work is roughly estimated.

*In favor of loads. †Against loads.

it requires a rather tedious search to discover one. The losses due to this cause must be small indeed, as a leak of any importance is readily heard by any person within a radius of 10 feet.

The compressed air locomotives are operated over about 18 miles of standard gauge track laid with 60-pound rails, located inside of an irregular area about half a mile square. The reduction works are located on a side hill, and

Outside the buildings the locomotives are subjected to extremes of weather. At an elevation of 5,000 feet above sea level, at Anaconda, Mont., the range of temperature is from 95 degrees above zero to 35 degrees below, with heavy snows and high winds. Under these conditions the records of the company show that the compressed air locomotives, during the months of January, February and March, 1905, lost 5¾ hours for one locomotive

out of a total of 23,320 locomotive-hours, distributed among thirteen locomotives. These records show all delays chargeable to failures of the transportation system and are kept with great exactness.

The new reduction works were first operated in February, 1902. The locomotives in question have been the only means of internal transportation since the first pound of copper was produced, and the nine original locomotives, purchased in November, 1900, which were used during construction, are still in service and apparently as good as new, except for the necessity for regular running repairs. The tabulated data on page 4077 give a rough idea of the work which is being performed.

It should be understood in reviewing the table that it does not by any means represent all the work done by the locomotives. The first omission is the movement of the locomotives themselves, both when hauling trains and when running light from point to point; second, the endless "spotting" and shifting that is necessary in order to weigh, load and unload the material hauled. For example, in the case of the locomotive hauling hot metal, the cars or ladles must be "spotted" for weighing three times on each round trip, in addition to three other stops—two for loading and unloading, and the third for cleaning the ladle, this latter operation being performed on a spur leading off a Y.

In the case of the three locomotives hauling coarse concentrates, first-class ore, flue dust, slag, and limestone from the stock bins and brick plant to the blast furnaces, each carload must contain its proper proportion of each of the various ingredients, and each car must be "spotted" under the proper chute and weighed after each class of material is put in. At the other end, the train of from sixteen to twenty cars is moved back and forth eight or ten times in placing the various cars so that they can be unloaded in the proper place, in the proper furnace. Even the easiest runs involve at least two weighings of the train—one loaded and the other empty—and several shifts to place the cars at the proper points for loading and unloading. All this is necessary in order that the efficiency of the various operations may be traced at all times.

Samples of crude ore, concentrates, calcines, slags, flue dust and the metallic product of the blast and reverberatory furnaces, together with the black copper from the converter, are taken daily and analyzed. This combination of systematic weighing of all materials after every process, with daily sampling and analyses, enables the management to detect and stop promptly any unusual losses in the process.

To do this work, locomotives were required that were self-contained, reliable, powerful, smokeless, compact and simple in operation. With steam locomotives the smoke and steam in the tunnels under the bins and furnaces would have made it almost impossible for the locomotive runner to see the signals. Electric locomotives would have required trolley wires or a third rail, either of which would have introduced serious difficulties in many locations too obvious to require explanation. Storage battery electric locomotives might have been used, but they are not adapted to severe and continuous service, and require too long a time for recharging the batteries or changing the cells.

When the reduction works were built the engineers in charge decided in favor of compressed air locomotives as the best solution of the transportation problem. Their successors who now operate the plant apparently agree with them, as they have purchased additional compressed air locomotives, and have extended the system to cover movements of materials which the constructing engineers did not consider in connection with the original design. The writer heard but little criticism and much commendation. The general opinion of the operating force is thus summarized: Under their conditions, compressed air locomotives are unsurpassed for convenience, reliability, and simplicity of operation.

Taking up the question of economy, the labor cost of operating the system is as low or lower than it would be with any other system. With them the cost of power is also extremely low, as the steam is generated by waste heat from the reverberatory furnaces; but as the question of steam economy is of considerable interest under other conditions, and as an absolute determination was impossible under the circumstances, the writer will attempt a few comparisons, trusting that they may be found of interest.

During the month of April the two compressors were operated continuously twenty-four hours a day, one at an average speed of 38.8 revolutions per minute; the other at 44.1

revolutions per minute. Under these conditions the total power developed would be 721 horse-power for both compressors, or an average of about 66 horse-power for each locomotive in operation. Ten out of the eleven locomotives in operation will develop 5,700 pounds tractive force; the remaining locomotive will develop 9,180 pounds. The speed is limited to 5 miles per hour.

Each one of the smaller locomotives would therefore be developing

$$\frac{5700 \times 5280 \times 5}{60 \times 33000} = 76$$

horse-power at times; the large one

$$\frac{9180 \times 5280 \times 5}{60 \times 33000} = 122$$

horse-power, giving a total of $76 \times 10 = 760$, added to $122 = 882$ horse-power.

The approximate kilowatt input of an electric locomotive of the same weight as the smaller type of compressed air locomotive would be 95, and for the larger size 150; total, $95 \times 10 = 950$; $150 \times 1 = 150$; $950 \times 150 = 1100$ kilowatts.

If we assume that not more than one-half of the total rated capacity of the locomotives, to which must be added 5 per cent., we have 550 kilowatts, or $550 \times 1.34 = 737$ electrical horse-power at the locomotives, to which must be added 5 per cent. for line losses, 5 per cent. for dynamo losses, and about 7 per cent. for the friction of the engine; $737 \times 1.17 = 862$ for the indicated horse-power of the engine driving the dynamo to operate the same number and weight of electric locomotives, with occasional overloads and the extreme fluctuations incident to the operation of electric locomotives. It does not seem, therefore, as though electric locomotives under the same conditions would be much more economical of steam.

As compared with steam locomotives, in order to make an intelligent comparison we must go back to the coal pile, even though the steam necessary to operate the compressed air locomotives at the reduction works is obtained from boilers that are run by waste heat.

The two compressors, under normal conditions, required 323,100 pounds of steam per day of twenty-four hours. By referring to the table on page 4077 we see that there are thirty-one eight-hour locomotive shifts in each day of twenty-four hours. Assuming, for the sake of comparison, an evaporation of 7½ pounds of water per pound of coal, we find that to furnish steam for the compressors, 43,080 pounds of fair coal would be required, or, say, 1,400 pounds of coal per compressed air locomotive shift. The writer has in his possession reports on the performance of twelve steam locomotives, having cylinders 9 inches in diameter by 14 inches stroke, which used from 760 to 2,400 pounds of coal per day of ten hours, averaging about 1,340 pounds.

Assuming that steam locomotives at the reduction works would use approximately the same quantity of fuel per hour, we have 1,072 pounds for the small locomotives per shift, and 1,500 pounds for the large one, giving a total of $1,072 \times 29 = 31,088$, $1,500 \times 2 = 3,000$, $31,088 + 3,000 = 34,088$, or, say, 17 tons of coal for the steam locomotives doing the same work, as against 21½ tons for the compressed air locomotives.

These calculations are, of course, nothing more than crude approximations, and are presented only as indicating that any change which might be effected in the cost of steam to operate the transportation system by substituting another form of motive power would be of minor importance when considered in connection with other expenses and the other desirable qualities of the existing system.

The cost of maintenance must certainly be less than with steam locomotives by about the amount necessary to wash out and keep in repair thirteen small locomotive boilers, as the cost of keeping the main storage tanks on the compressed air locomotives in repair has been nothing. The remainder of the machinery of the compressed air locomotives being so nearly the same as that of the steam locomotive, there is no reason why there should be any difference in the cost of maintenance. The writer is of the opinion that the repairing of saddle tanks and the renewing of grate bars on steam locomotives would about balance any expenditure for maintenance of a stationary plant, including the boilers.

In comparing the cost of maintenance with electric locomotives no such direct deductions are possible. The machinery is radically different, and the friends of both systems claim superiority in this respect for their favorites. With the electric locomotives, dust and dirt are more easily kept away from the wearing parts; but the same casing that keeps out the

dust prevents the free circulation of air around the armature and commutator, and renders them more liable to injury from overheating. So little reliable data is to be had that it is all a matter of opinion. Figures have been published showing that compressed air locomotives are more economical to maintain than are electric locomotives, but there are no detailed and reliable figures to show electric locomotives more economical than compressed air locomotives.

One set of figures, however, does not settle the matter. Probably local conditions and designs have more to do with the relative cost of maintenance than any inherent qualities of the two systems. Compressed air locomotives have this advantage: Charge after charge of air may be used in quick succession, with the locomotive working at all times at full capacity without injury. This is not true of electric locomotives. The electric motors which drive the locomotives are so designed that they can be run for one hour at rated draw-bar pull and speed without injurious heating, provided the motors are started cold. As a rule, this provision is sufficient, but occasionally it is not, and a burnout occurs.

The problem of internal transportation in many large establishments is a serious one, and during the writer's stay at Anaconda the many advantages of compressed air locomotives for such service were so manifest, and the evidence that their development had reached a stage justifying the confidence of engineers and business men was so conclusive, that a brief account of what was being accomplished with this form of motive power seemed of general interest.

Compressed air locomotives, however, have their limitations. They are not intended for long continuous runs in one direction, and their efficiency would be relatively low where starts and stops were infrequent; but for service conditions similar to those existing at the Anaconda Copper Mining Company's new reduction works there would seem to be a wide field of usefulness, more especially where waste heat from heating or blast furnaces, or the refuse from woodworking establishments, or water power, could be utilized to operate the compressor, thus saving the fuel necessary to operate steam locomotives, doing away with trolley wires, and eliminating all risk of fire.

AIR COMPRESSOR LUBRICATION

Mines and Minerals makes the following statement in regard to the lubrication of air compressors:

"Excess of lubrication, in addition to waste, means increased accumulation of combustible matter, increased lodgment of dust and increased danger of accident. Just as little lubricant should be used as possible.

"Two lubricants are in general use on air compressor cylinders, a mixture of soap and water, and cylinder oil. Either can be made to do the work. The mixture of soap and water has inferior lubricating properties and must be used in quantities. One case of explosion is reported where soap and water was used almost exclusively. A test of the deposit found in the receiver after the explosion showed that it readily ignited at 400 degrees F., the deposit being 2 inches thick.

"The mixture of the soap and water was also tested in a laboratory and upon being evaporated down to a 'black semi-solid mass' ignited at 500 degrees F. The principal combustible ingredient in the deposit was coal dust.

"This case is sufficient to show that the use of soap and water is not a sure preventive of accidents. In fact, it goes further and shows that soap and water may not be as good as oil, for the tests showed that it burned readily when dry, and in-as-much as more of it would have to be used than of oil, the deposit of dust would be correspondingly greater. Nevertheless, soap and water may be used to good advantage and provision should be made for its introduction into the cylinder when necessary."

FRANCIS FOX states that the length of the Simplon tunnel, which is 12½ miles, is greater than was planned by 31 inches. The levels of the two galleries were within 3½ inches of one another. The axis of the tunnel, driven from the north end, deviated 4⅓ inches toward the west, while the line driven from the south end deviated 3⅔ inches toward the east; the greatest divergence from the true line, 3⅓ inches, is well within probable error.—*Engineering and Mining Journal.*

COMPRESSED AIR

Established 1896.

A monthly magazine devoted to the useful applications of compressed air.

W. L. SAUNDERS, Mem. Am. Soc. C. E., . Editor
W. R. HULBERT, M. E , . Managing Editor
P. F. KOBBÉ, JR , . . Business Manager

PUBLISHED BY

THE KOBBÉ COMPANY,
90-92 West Broadway,
New York.

Subscription, including postage, United States, Canada and Mexico, $1.00 a year. All other countries $1.50 a year.. Single copies, 10 cents.

Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

All communications should be addressed to COMPRESSED AIR, 90-92 West Broadway, New York.

London Office, 114 Queen Victoria Street.

Those who fail to receive papers promptly will please notify us at once.

Entered as Second-Class Matter at the New York, N. Y., Post Office.

Vol. XI. JUNE, 1906. No. 4.

CONTENTS.

AIR LIFT PROBLEMS.

We should like to call the attention of our readers to the inquiry of Mr. William Schock in regard to his air-lift system, which we print under the head of "Practical Items for Practical Men," in this issue of COMPRESSED AIR. While we have given Mr. Schock what information we could in regard to his problem, we should like to hear from our readers and obtain their opinions in this matter. As far as we can determine nothing has been written upon the subject of carrying water horizontally in air lift pumping plants and there is, therefore, no information regarding the effect of horizontal piping upon the capacity or efficiency of the system. It is out of the question to look to the manufacturers of air lift pumping systems for this information as it is against their policy to give out any more data than they can help, owing to the fact that the gathering of such data has been of great expense to them and they do not wish to allow their competitors to profit by it. This stand may be a perfectly correct one and justified by competition, but at the same time the information is of considerable value and offers an excellent opportunity for original research on the part of engineers who are in a position to make the necessary tests. It also offers an original subject of investigation to technical graduates who desire to break away from the time-worn theses subjects usually adhered to. If, therefore, any of our subscribers have any information on this subject, they will be conferring a lasting benefit on a large number of the readers of this magazine if they will make their knowledge public.

DENATURALIZED ALCOHOL.

There seems to be a better chance this year than ever before that Congress will pass the bill removing the internal revenue tax on denaturalized alcohol for use in the arts. The House, at this writing, has already passed the measure and the Senate will show an immeasurable indifference to public opinion if it fails to do its share in making this important bill a law.

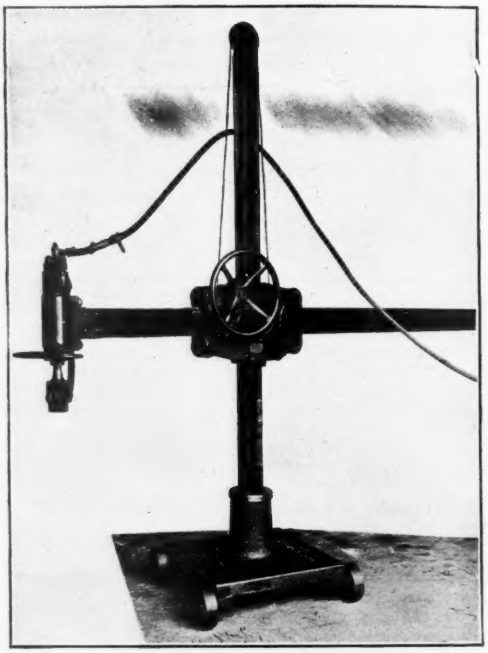
Denaturalized alcohol free of tax will compete most successfully with kerosene as an illuminant and with gasolene as fuel. In Germany and Great Britain denaturalized alcohol has been untaxed for many years, and has

been used in enormous quantities for various manufacturing processes. For illuminating it is used with a Welsbach mantle and will give 1,471 candle-power hours per gallon burned, as compared with 783 candle-power hours from a gallon of kerosene burned in a kerosene lamp. Tests at the University of Brussels have shown that alcohol at 31 cents per gallon is as cheap for lighting purposes as kerosene at 15 cents per gallon.

For use in motors, alcohol does not possess quite so great an advantage. Its efficiency is substantially the same for this purpose as gasolene, about one pint per horse-power hour. While alcohol only possesses half the number of heat units per pound that gasolene does, the alcohol vapor can be compressed to a much higher degree than gasolene without causing premature ignition, and, consequently, the thermal efficiency of the alcohol engine can be made about 30 per cent., as compared with 21 per cent. to 22 per cent. for the gasolene engine. The exhaust from an alcohol engine contains a less number of injurious gases than the exhaust from gasolene motors, and it has been proposed, therefore, to build alcohol locomotives for use in mines. Even with the higher efficiency, however, it is to be doubted whether alcohol will compete successfully with gasolene unless its cost can be materially reduced, it being estimated that it cannot be manufactured for less than 25 cents per gallon. In Cuba, however, it is said to be produced on sugar plantations from refuse molasses at a cost as low as 10 cents per gallon. It is to be hoped, therefore, that improved processes may be developed so that denaturalized alcohol may be produced for 15 cents per gallon, or less, in this country, in which case it would prove a most valuable fuel for the operation of direct combustion engines, the supply being practically inexhaustible and, it being possible to manufacture alcohol almost anywhere, there will be no necessity for payment for long freight hauls.

A NEW STONE DRESSING MACHINE

The Thomas H. Dallett Co., of Philadelphia, has lately brought out a new large stone dressing machine of the sliding-arm type. The tool has several novel features. By taking off two nuts at the top of the tool, the valve-box, valve, piston and barrel can be removed, and on being replaced, there are no adjustments to be made, the parts being replaced in their order and the nuts screwed down tight. Economy in the use of air has received a great deal of attention during the design and development of the tool, not only to render it long-lived, but also to reduce the air consumption to the minimum. At 80 lb. pressure the tool will consume about 50 cu. ft. of free air per minute, and at lower pressure a correspondingly less quantity. All parts of the tool are hardened and accurately ground. The exhaust hose can be



attached to either side of the tool, blowing the dust from the working surface of the stone in either direction, as the operator may desire.

The upright consists of two parallel bars, with separating pieces between, the whole securely riveted together. On the lower end of this standard is cast a massive cylindrical journal, becoming an integral part of it and forming as a whole a bifurcated rotatable upright. The journal rotates in the bearing formed in the upright extension of the base. This bearing is lubricated with grease and protected from the cutting action of the stone-grit by a leather cap, which fits over the top of the bearing. The bearing surface is 17 in. long and 6½ in. in diameter.

The horizontal arm carrying the tool is a 6-in.. I-beam, with the sides faced with oak. This arm travels back and forth on rollers mounted in the carriage, which is movable up and down on the upright by means of the hand-wheel, drum and ratchet, as shown in the cut. The position of this horizontal arm between the bars formin~ the upright, throws

all the weight and strains directly through the centre-line of the upright, which is important in minimizing wear and is conducive to easy operation.

The rollers of the carriage, on which the horizontal arm travels back and forth are a very hard cast iron, with case-hardened bushings inserted. The side plates and the different parts of the tool holder are crucible steel castings. Another important feature is the spring device in the carriage, whereby a constant tension is maintained between it and the upright. This eliminates wear and rattling of the carriage on the upright, besides allowing a flexibility of movement, to a certain extent, of the tool over the inequalities of an uneven stone that is of much assistance to the operator.

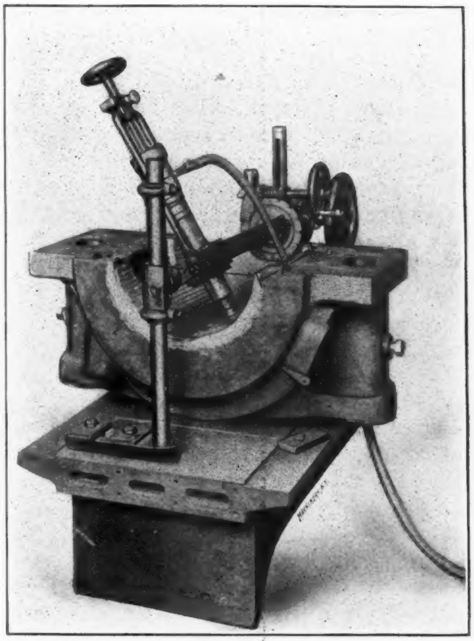
The base of this machine weighs 700 lb., which is sufficient to insure the stability of the machine when the carriage is at the top of the upright and the arm fully extended, without the necessity of weighting down or clamping to the track. The base is ordinarily furnished with flat wheels, as shown in the cut, but when desired flanged wheels will be provided. The net weight of the machine, complete, is 1,600 lb.

For the export trade the Dallett Co. has adopted a novel expedient to save freight charges incident to forwarding to foreign countries the heavy iron base. For export they provide what they term their "export base," which is simply the upright bearing, provided with a flange on the bottom, so that it may be bolted to any description of base that the foreign purchaser may desire. The weight of this bearing is about 200 lb., so that when boxed for shipment the whole machine, with the export base, complete, weighs 1,400 lb., and occupies but 26 cu. ft.

PNEUMATIC BABBITT BEATING MACHINE.*

The pneumatic babbitt beater, shown in the accompanying illustration, was designed and patented by Charles Hightower, late assistant superintendent of the Union Iron Works, of San Francisco, Cal. It will undoubtedly fill a long-felt want in the machine shop—not only from a practical standpoint, but from an economical one as well.

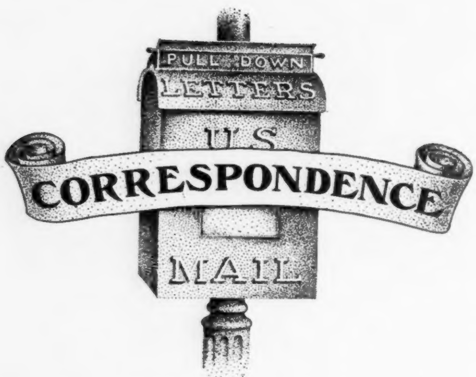
Beating babbitt by hand, as we all know, is very expensive and at the same time not altogether satisfactory. The job is usually done by one of the shop laborers, who does not understand the importance of properly beating the babbitt, until it is well into the dovetails provided for securing it in place, and at the same time closes up the pores of the metal, together with any possible blowholes that might have occurred in pouring, and to this fact may be traced a good deal of the trouble given by babbitted journals and surfaces. While the work done by the machine may also have its faults if the machine is not skillfully handled it will be seen that there is no comparison between the two methods of beating babbitt as far as the cost of production goes. The cap, shown in the illustration, is 16 inches long, with a bore of 15½ inches, and it was beaten in nine minutes. The machine, as may be seen, is of very crude con-



struction, having been built entirely for experimental purposes. As the principle is clearly shown in the cut, consisting of a suitable frame for holding and traversing a pneumatic hammer an explanation as to the construction and operation is hardly necessary; sufficient to say that it gives entire satisfaction and promises to be a welcome addition to the modern machine shop.

*By W. S. Atkinson, in Machinery.

Intelligent rock drillers will usually drill long holes when possible. Comparatively short holes must be used in stoping in some places, but the policy of putting in long holes, even if they are of smaller diameter at the bottom, is not contrary to the best practice.



The Editor of "Compressed Air":

DEAR SIR—Will you kindly favor me with the information as to the proper distinction between compressed air and air delivered by a blower or fan? THOMAS G. SAXTON.

Compressed air is generally considered to mean air above 20 or 30 lbs. gauge pressure. A centrifugal fan or blower is not adapted to maintain a pressure higher than about 16 oz., and any pressure between this and 20 lbs. is maintained by a blowing engine. A blowing engine is practically the same as a compressor except that its exhaust valves are usually positively controlled. Compressed air for commercial purposes is usually used at pressures from 60 to 100 lbs. gauge.

The Editor of "Compressed Air":

DEAR SIR—Would you please let me know the capacity in free air per minute of a compressor 3⅛ inch bore, 4 inch stroke, speed 500 R. P. M. single acting? Also how close the piston must come to the cylinder head to compress 100 lbs. WILLIAM SCOTT.

A compressor of the dimensions stated above, operating at 500 R. P. M., single acting, would displace 8.75 cu. ft. of free air per minute. This would be piston displacement only, however, and would not represent the capacity of the machine unless an allowance were made for volumetric efficiency. As the volumetric efficiency of high speed machines is usually low, the machine in question would probably not deliver more than 7 cu. ft. of free air per minute. In regard to clearance in this compressor, there is no set rule, as it is universal practice to make the clearance as small as is mechanically practicable. Some companies have a rule that clearance in all sizes of machines shall not be greater than 1-16 inch between piston and cylinder head. It will be seen, therefore, that if the distance between the cylinder head and piston remains the same for all sizes of cylinders, the percentage of cylinder volume, represented by this clearance, increases as the diameter of the cylinder decreases.

OXY-ACETYLENE BLOWPIPE.

The oxy-acetylene blowpipe produces a very high temperature, being in the neighborhood of 4,000 degrees C. It promises to be a very valuable means of welding plates together and for other purposes requiring high temperature. The proportion of oxygen and acetylene may be regulated so as to make the flame either an oxidizing or reducing agent simply by giving excess of oxygen or acetylene as may be desired. One great advantage of the new blowpipe is that both oxygen and acetylene gases may be generated as desired, thus doing away with the necessity of transporting them in cylinders under high pressure. The acetylene gas is of course generated by the combination of water and carbide of calcium, and oxygen may now be produced by the combination of water and peroxide of sodium which is sold under the trade name of "oxone."

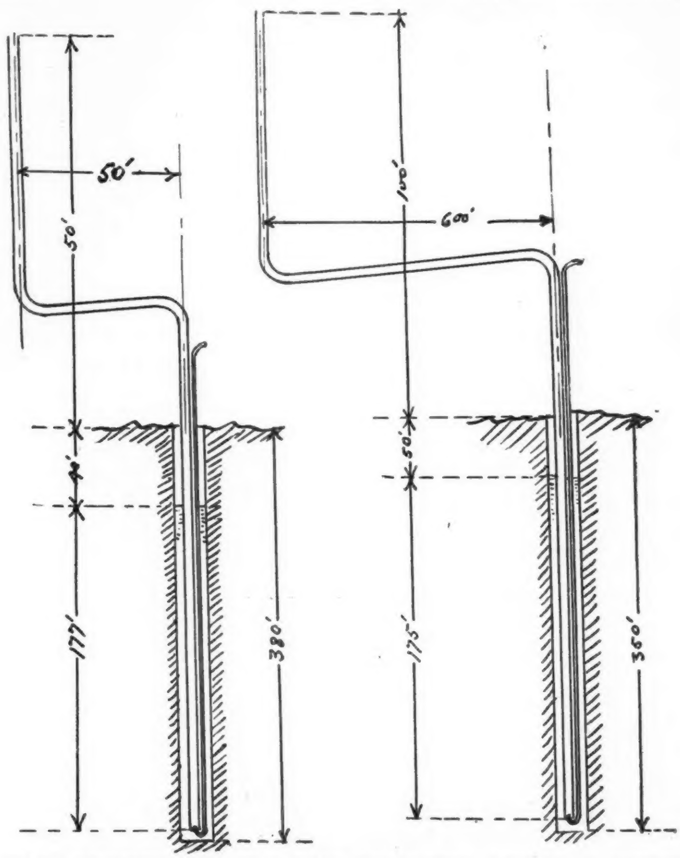
EDISON AIR REHEATER.

The Edison air reheater consists of two concentric cylinders. In the inner one a coal fire is built, while a portion of the compressed air is passed through the space between the cylinders, and a portion is conducted through the fire. Valves are arranged to regulate the proportion of air passing through the fire. The work is intermittent, as the reheater must be opened and emptied before a fresh supply of fuel can be added. When properly lagged with asbestos, 90 per cent. of the heat units of combustion are imparted to the air as well as all the gases produced by the burning coal. The result is that a horse-power may be added to the compresser air by burning 0.4 lb. of coal. This is far below results obtained in any type of steam or gas engine. Two men are required to operate it, and the temperature to which it will raise is uncertain. Sometimes the fire goes out after the reheater is closed; sometimes too much air passes through the fire, and all the ashes are carried along with the air; and sometimes the fire burns so hot that the air is raised to temperatures which make lubrication impossible, even exceeding 1,000 degrees Fahrenheit.

PRACTICAL ITEMS for PRACTICAL MEN.

WHAT'S THE MATTER WITH THIS AIR LIFT SYSTEM?

The above inquiry was made to us by Mr. William Schock, who states that the system was supposed to raise 150 gallons of water per minute from both wells combined, but that the most he can get from them is from 90 to 100 gallons per minute.



ROUGH SKETCH OF WILLIAM SCHOCK'S AIR LIFT SYSTEM.

The wells are operated by a compressor having a 10" x 14" cylinder and operating at 100 r. p. m. Air pressure at receiver equals 90 lbs. gage. Discharge pipe equals 3" diam. Air pipe equals 1¼" diam. for both wells.

This compressor should have a displacement capacity of 127 cubic feet of free air per minute.

The other conditions relating to this problem can be obtained from the drawings.

We should be interested in hearing from our readers in regard to this subject.

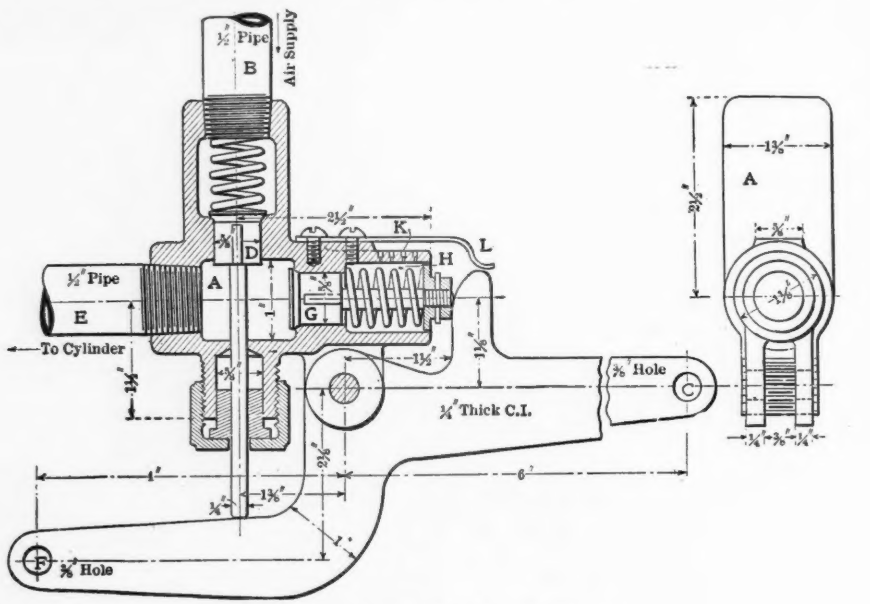
To convert a machine-drill into a trip-hammer, simply upset a piece of drill-steel, forming a proper head thereon, and place this in the chuck in the same manner that you would the drill, tightening the bolts. The machine, of course, should be properly secured by means of strong "U" bolts to a suitable timber frame, so constructed that the anvil may be placed in position underneath the drill. When all is ready turn on the air, the same as though you were going to drill a hole in the rock. The intensity and speed of the blows is regulated by the amount of air turned in, or by the pressure, which may be controlled. No special valve gear or any change in the machine is necessary.

OPERATING VALVE FOR AN AIR HOIST.

The writer had occasion to build several air hoists recently for use in various departments of our works. These hoists were of the single-cylinder straight-lift type, the cylinders being made of 4½ and 6-inch thin tubing of various lengths, four feet being the usual lift required.

The principal parts of these hoists were the operating valves, which are illustrated in the accompanying sketch. They have proven very satisfactory.

The body *A* is a brass casting with the air inlet through the ½-inch pipe *B*. To cause the hoist to lift, the hand rope which is attached to the operating lever at the hole *C* is pulled downward, thus lifting the valve *D* from its seat; the air then passes through the valve *D* into the chamber *A* through the ½-inch cylinder pipe *E*, which leads to the under side of the hoist piston. When the load is raised to the required height and it is desired to lower it, the hand rope at *C* is released and the valve *D* will fly down upon its seat, where it is held by the coiled steel spring and the pressure in the supply pipe; the load will remain at this height until released, provided there are no leaks. To release the load, pull the rope attached at the hole *F* in the lever, thus pushing the exhaust valve *G* from its seat. The air in the hoist then passes out through the pipe *E*, the chamber *A*, the valve *G* and the chamber *H* to the atmosphere through the small perforations *K* which muffle the exhaust. The exhaust valve is held on its seat by a coiled steel spring; this spring also assists the 1-16x½-inch flat steel spring *L* in keeping the operating lever in a horizontal position.—*American Machinist.*



OPERATING VALVE FOR AN AIR HOIST.

A GOOD scheme for washing blue-prints is that seen at the general office of a mining company not long since. The tank in which the prints are washed is vertical, instead of horizontal (as usual), and has at the top a shade roller about 3 in. diameter. This rests upon a pair of rollers at each end, and turns freely; a perforated pipe is arranged at one side of it, and delivers small streams of water against the face of the blue-print. The latter, preparatory to washing, is pinned together at the ends and the shade-roller inserted; the roller, with the print hanging from it into the tank, is replaced and the water turned on. A quick turn of the roller, together with the streams of water directed against the print, keeps the latter in motion for a sufficient length of time to insure thorough washing.

CHIPPINGS.

The Stanley-G. I. Electric Mfg. Company have opened temporary offices at 67 Blake Block, Oakland, Cal. Several carloads of electrical apparatus have already left Pittsfield to take the place of machinery damaged or destroyed in the California disaster.

It is not claimed even by air compressor builders that compressed air is a cheap medium for developing power underground; but in almost every mine there is to be found one or more places where a compressed-air pump is the simplest, most convenient and most desirable way of handling the water at that point.

We are advised that the Sullivan Machinery Co. have established a temporary office at 1010 Washington street, Oakland, Cal., to take the place of their regular San Francisco branch recently destroyed. They are now in a position to give prompt attention to orders through Mr. H. T. Walsh, Pacific Coast Manager, who is carrying a stock of rock drills and parts as well as air compressors.

Ores and Metals announces that from this time on it will be published by Reinert Brothers, of Denver, Col. Under the new management the paper has been enlarged and considerably improved both in appearance and in the quality of its contents. Those who know the present publishers have no doubt that the improvement will continue. The new *Ores and Metals* will be edited by Mr. Carl H. Paddock.

To heat 700 cu. ft. of free air from 60 deg. to 353 deg. F., when under 65 lb., requires 12,800 B.t.u. per minute. Allowing 50 per cent. as the efficiency of the reheater (a figure which tests of standard types have shown to be fair), we must develop 25,600 B.t.u. in the reheater per minute, which will require about 2 lb. of coal per minute, or about 2900 lb. per 24 hours. These calculations are based on installation at an altitude of 5,000 feet.

Quite an interesting drilling competition was recently held on the Lancaster West mine. On this mine kaffir labor is employed, while Chinese are used on the next mine, the Lancaster. The white miners of the Lancaster West boasted they had a Kaffir who could drill better than any Chinaman. A competition was arranged and the Chinaman beat the Kaffir easily, drilling 156 in. in about 7 hours, while the Kaffir drilled 140 in. It is found that the Chinaman is an excellent driller provided the conditions are favorable. Otherwise he loses heart.—*Engineering and Mining Journal.*

As to "star" vs. "chisel" bits, some drillmen say that in all cases star starters and seconds should be used. Then practical knowledge on the part of the man and his boss must decide as to whether the conditions are most favorable to the use of chisel or star. According to one opinion, an ideal set of drills is made of 1⅛-in. steel; starters, 3 in. diameter; seconds, 2½ in.; thirds, 2 in.; a long star, 1¾ in., and then chisel up to 9 ft. or 10 ft. Drills of the same length in the same set should vary in the size of their cutting edges.

It is almost useless to attempt to reach a conclusion as to the relative merits of air and electric drills. There are so many considerations that no definite statement can be made save in individual cases, where the natural prevailing conditions are a deciding factor. The air drill is considered to be less easily broken than the electric drill, but on the other hand it is claimed that air installations suffer greater line losses and are less efficient. The electric drill is growing in favor, but still has an enormous lead to overcome.—*Mining Reporter.*

Compressed air locomotives, which in the past few years have become so largely used for mine haulage, work under pressures ranging from about 500 to 2,000 lb. The pressure is mainly determined by the size of the locomotive permitted by the tunnels and curves. In tunnels of good size the large reservoirs needed for low-pressure engines are permissable, but where only small receivers can be used, it is necessary, in order to carry the required supply of power, to compress the air to a higher degree in strong steel tubes, "bottles" as they are sometimes called.—*Engineering and Mining Journal.*

The present standard type of air reheater consists of two concentric cylinders having about ¾-in. space between them. A coal fire is maintained within the inner cylinder, which

is provided with a gate at the bottom end, and a smoke pipe at the top. The compressed air is conducted through the space between the cylinders where it takes up about 50 per cent. of the heat units developed by the combustion of the coal, the remaining 50 per cent, escaping up the stack and by radiation. In tests made with reheaters of this type, in which the air was raised from 52 deg. F. to 350 deg., an increase of 54 per cent. was found in the work performed by a given amount of compressed air.

A plant for the manufacture of liquid air, purchased out of the Boylston hall laboratory funds, has recently been installed in Boylston hall, Harvard. It consists of a four-stage compressor, built by the Norwalk Iron Works Company, which is operated by a Crocker-Wheeler 20-horse-power motor. The compressed air is condensed by a new and original type of liquefier designed by Prof. W. P. Bradley of Wesleyan university and built under his direction. The capacity of the plant, which is the most efficient and powerful yet devised, is about half a gallon of liquid air per hour.

In the compressed-air street car service tried in New York some years ago the compressed air was stored in a tank under high pressure, while a second tank containing hot water was used as a reheater, the air being allowed to pass through the water before entering the engine. In trials made with these cars it was found that when using the reheater a car would run over six miles on one charging of the air tank, while without a reheater it would only run between three and four miles.—*Engineering and Mining Journal.*

A new hoisting rope should be oiled within two or three days of its being put to work. The oiling should be repeated at least once a month during the first six months, and after that every six weeks. In a dry downcast shaft this may be considered needlessly frequent, but in an upcast, or a wet shaft, it may be required more often. The process of oiling affords an excellent opportunity for examination of the condition of the rope. The oil can be removed by cotton waste, soaked in paraffin, from any part where a defect is suspected.

Pneumatic locomotives are employed in some of the large German collieries. The engine is constructed like an ordinary steam locomotive. An air-storage tank takes the place of the boiler. The air is stored under pressure varying from 700 to 1,000 lb. per sq. in. In some of the engines the air passes into an auxiliary reservoir before entering the cylinders. The air pressure is reduced to about 150 lb. per sq. in. before entering the engine cylinder. The air is used expansively by means of the Stephenson link-motion gear. This system of underground haulage is cheaper and handier than rope haulage, and it is thoroughly safe and reliable.

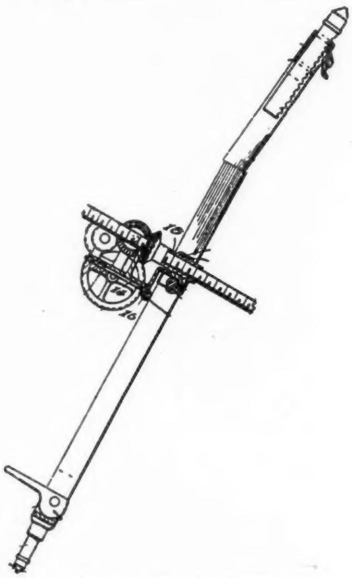
A practically necessary feature in mining in the Cripple Creek district in Colorado is the use of the rock drills driven by compressed air. The air compressor plant is usually placed near the mouth of the shaft and the air supplied to the drills at different levels through pipe lines extending down into the mines. The mines are worked at various levels, reaching a working depth in several instances of 1,000 feet. The rock encountered, especially at the lower levels, is very dense and not easily drilled. The economical operation of a mine in this district thus depends largely on the cost of compressing air, owing to the high price of coal. The range in the cost of coal for this work is from 53 cents to \$3 per drill shift. This difference is, of course, due to the care and intelligence with which the machinery is operated and to the design and character of the latter.

The results obtained in two mines of the Cripple Creek Consolidated Co. covered by a period extending over four months are interesting in demonstrating that low costs can be obtained in practice under proper operating conditions. During the four months referred to 1,367 drill shifts were operated in these mines, 492 shifts being the largest number employed in a single month. The cost of coal used in operating the two mines during this time was \$1,183.17, of which \$450 was spent for coal used in hoisting 7,500 tons or rock that was removed. The total cost of coal required in operating the compressor was thus \$733.17, or 53.7 cents per shift. A straight-line air compressor, with single steam and compound air cylinders, made by the Sullivan Machinery Co., of Chicago, Ill., was used. This compressor is designed to operate 10 standard rock drills, but the rated capacity was often exceeded during the time mentioned.

U. S. PATENTS GRANTED APRIL, 1906.

Specially prepared for COMPRESSED AIR.

816,562. MINER'S DRILL. Clyde C. Cranmer, Athens, Ohio. Filed March 2, 1905. Serial No. 248,174.



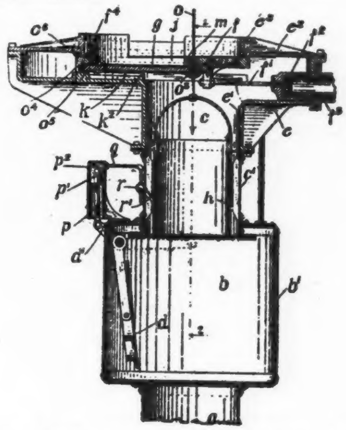
Claim.—1. In a miner's drill, the combination of a supporting-post, a supporting-frame connected with the upright, and a slidable plate carried by said supporting-frame and adapted to hold the same in an ascertained position.

816,563. MINER'S DRILL. Clyde C. Cranmer, Athens, Ohio. Filed Sept. 12, 1905. Serial No. 278,161.

Claim.—1. In a miner's drill, the combination of a supporting-frame, a drill-rod mounted thereon, a rotatable bearing for the drill-rod having threaded connection therewith, a main gear having spline connection with the drill-rod and adapted to rotate the same, means for actuating said main gear, adjustable bearing-brackets attached to the frame, and a train of gears mounted on said bearing-brackets and arranged to connect the main gear aforesaid with the rotatable bearing, whereby rotation may be imparted to said bearing, adjustment of the bearing-brackets above mentioned being adapted to connect or disconnect the main gear from the rotatable bearing as described.

816,642. AIR LOCK. Sinclair W. Chiles, South Bethlehem, Pa. Filed June 15, 1905. Serial No. 265,416.

Claim.—1. In an air-lock, the combination of a movable head having an aperture for the passage of the bucket and adapted, when moved in one direction to partially close the air-lock chamber, a valve member operatively connected with the head to close the aperture therein when said head is moved to partially close the air-lock chamber.



816,761. PNEUMATIC HORSE COLLAR. Ingebert J. Thomsen, Minden, Neb. Filed Aug. 22, 1905. Serial No. 275,267.

Claim.—1. The combination with a horse collar of pneumatic pads connected by a restricted air passage, and a valve controlling the passage of air through said air passage.

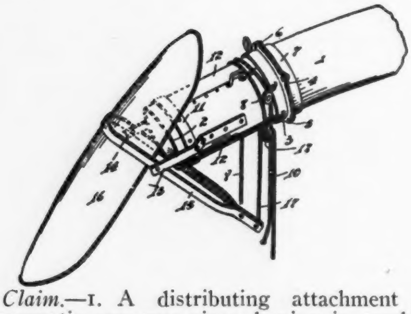
816,859. FLUID PRESSURE BRAKE. Maury W. Hibbard, Chicago, Ill. Filed July 6, 1903. Serial No. 164,324.

Claim.—1. In an automatic fluid-pressure brake apparatus, having a movable abutment, governing the passage of pressure to the brake cylinder, and a passage for feeding pressure from the train pipe to the auxiliary reservoir, the combination of a separate movable flexible diaphragm device exposed on opposite sides to pressure from the train pipe and auxiliary reservoir respectively, and a valve in said feed passage actuated by movement of said diaphragm device to open said passage when the train-pipe pressure exceeds that in the auxiliary reservoir.

816,884. DETACHABLE PNEUMATIC TIRE. Chas. S. Scott, Cadiz, Ohio, assignor, by mesne assignments, to The Goodyear Tire and Rubber Company. Filed March 23, 1905. Renewed March 5, 1906. Serial No. 304,-264.

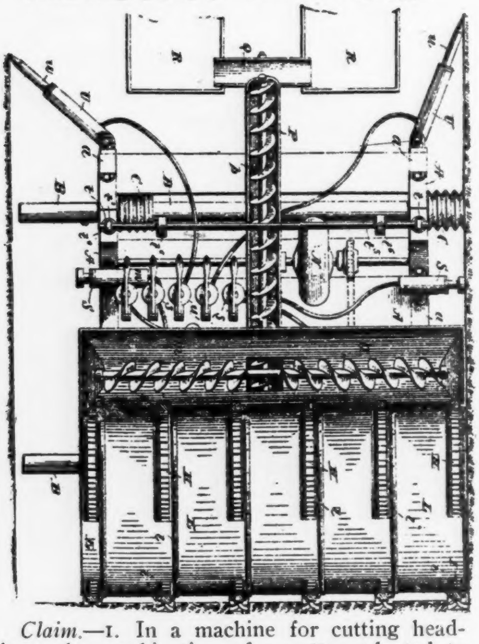
Claim.—1. The combination of a vehicle-wheel rim having a depressed groove near its detaching edge, an annular, inextensible, detachable, rim flange, having an inner diameter which permits its ready passage over the outer edge of the groove, and a contractible locking ring which is passed over the outer edge of the groove and sprung into the groove to form an abutment for the rim flange, substantially as described.

816,897. DISTRIBUTING NOZZLE FOR PNEUMATIC CONVEYER PIPES. Oscar E. Bray, Warsaw, N. Y. Filed Dec. 27, 1904. Serial No. 238,310.



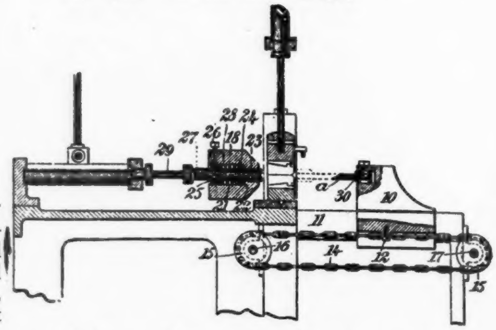
Claim.—1. A distributing attachment for pneumatic conveyor-pipes, having in combination a sleeve rotatably engaging over the end of said pipe, a plurality of collars rigidly fixed to said pipe, one at each end of said sleeve, strut members projecting from said sleeve past the outer end of said pipe, a directing-shield, a holder carrying the same, pivotally mounted between said strut members, and a plurality of cord system, one whereby the sleeve may be rotated in either direction with respect to the pipe, and the other whereby the position of said deflecting-shield and holder with respect to the sleeve and the pipe-terminal may be regulated, substantially as described.

816,923. Machine for Cutting Headings. William A. Lathrop, Wilkes-Barre, Pa. Filed Aug. 31, 1903. Serial No. 171,437.



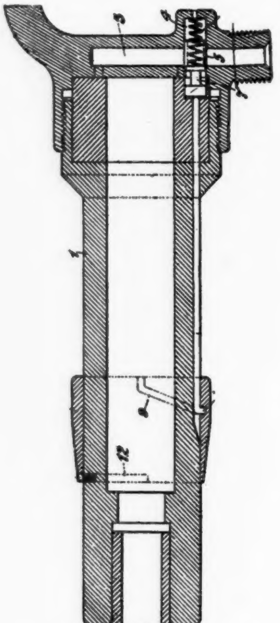
Claim.—1. In a machine for cutting headings, the combination of a cutter adapted to cut a channel transverse to the machine, which channel shall be as long as the corresponding transverse dimension of the machine, and means for moving said cutter laterally to widen said channel.

816,961. Drill Sharpening Machine. James J. Brossoit, Grand Rapids, Wis. Filed Dec. 20, 1904. Serial No. 237,599.



Claim.—1. In a machine for sharpening drills, the combination of a housing having a passage therethrough and a shoulder in the passage, a die arranged to move in the passage and having a shoulder coacting with the shoulder thereof, a collar secured in the housing, through which collar the die moves, a spring bearing between the shoulder on the die and said collar, and means for operating the die.

816,998. Throttle-valve for Pneumatic Hammers. Henry S. Potter, Bromley, England. Filed Jan. 4, 1905. Serial No. 239,661.

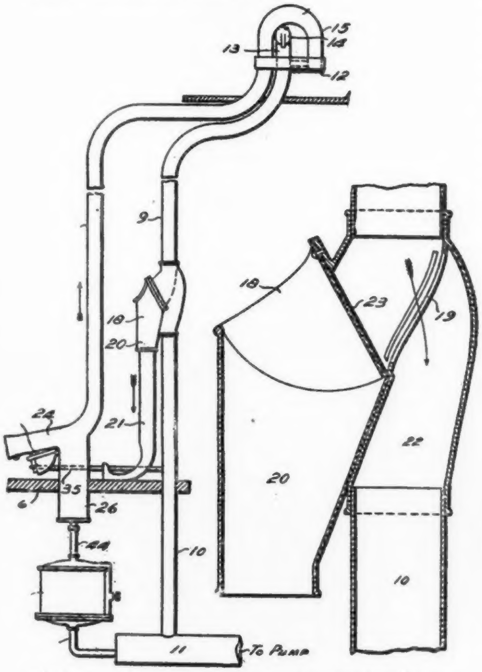


Claim.—1. The combination, with a power-cylinder having a closed rear end, of an oscillatory hand-operated sleeve encircling the front

end portion of the said cylinder, means for preventing the said sleeve from moving longitudinally, a supply-valve arranged at the rear end of the said cylinder, and a rod connection between the said sleeve and supply-valve.

2. The combination, with a power-cylinder having a closed rear end, of an oscillatory hand-operated sleeve encircling the front end portion of the said cylinder and provided for controlling the supply of pressure fluid, a toothed pinion gearing into the said rack, and a rod connection between the said plug-valve and pinion.

817,016. PNEUMATIC DESPATCHING TUBE SYSTEM. Joseph J. Staetzel, Chicago, Ill., assignor to Universal Pneumatic Transmission Company of Maine. Filed Nov. 20, 1905. Serial No. 288,175.



Claim.—1. In a pneumatic-despatch-tube system, the combination of a normally closed transit-tube through which carriers are transmitted, a sending-station arranged to permit a carried to be inserted into the tube, means for exhausting air from the tube, and a valve adapted to admit air into the tube for driving carriers, said valve being adapted to open through a fluctuation of the pressure within said tube, means normally urging the closing of said valve, and means for timing the closing of said valve.

817,066. PNEUMATIC TIRE. Sidney Hunter, St. Louis, Mo. Filed Sept. 21, 1905. Serial No. 279,435.

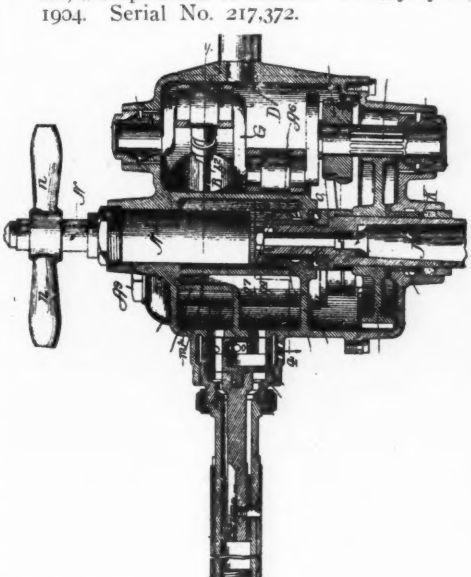
817,296. TUBULAR ROCK-BORING DRILL. William Besson, Duluth, Minn. Filed March 31, 1905. Serial No. 253,037.

Claim.—1. In a drill, the combination of a tubular drill rod, a reservoir formed on and around said rod at its lower end, a tubular drill point secured to the lower end of said rod, and having passages formed therein connecting the central passage of said drill point with said reservoir.

817,306. VACUUM SOLDERING MACHINE. Holton Eachus, Chicago, Ill., assignor to Fairbank Canning Company, Chicago, Ill., a corporation of Illinois. Filed May 6, 1905. Serial No. 259,207.

Claim.—1. The combination with a movable carrier having a plurality of compartments, and a plate adapted to cover two or more of said compartments successively as said carrier moves and having a suitable opening therein, of a vacuum chamber covering said opening, grooves in said plate connecting with said vacuum chamber and adapted to expose said compartments successively to the action of the vacuum as said carrier moves them under said plate, and means for soldering the vent in the caps of the cans contained in said compartments as they pass under said vacuum chamber, substantially as described.

817,384. PNEUMATIC MOTOR. Reinhold A. Norling, Aurora, Ill., assignor to Aurora Automatic Machinery Company, Aurora, Ill., a corporation of Illinois. Filed July 20, 1904. Serial No. 217,372.



Claim.—1. A pneumatic motor compressing a power cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply pipe, and a reversing

valve embracing a valve casing with which said supply pipe is connected, said valve casing being provided with an outwardly facing valve seat having two ports, both of which are in communication with said cylinder by supply and exhaust passages controlled by said cylinder valve, a rotative valve-disk bearing on said seat and adapted for bringing either of said ports in communication either with the air-supply pipe or with the outer air, a valve-operating stem connected with the valve and extending into said supply pipe, and a sleeve mounted to turn on said pipe and forming a hand grip, said sleeve being connected with said valve stem by operating means extending through a slot in said pipe.

817,538. Compound Air Pump. Howard Wixon, Chicago, Ill. Filed July 1, 1904. Serial No. 214,920.

Claim.—1. A compound pump comprising an outer, low-pressure cylinder having an internal packing at its end, a high-pressure cylinder working through said packing and having an external piston working in said outer cylinder, a piston carried by said outer cylinder and working within said inner, high-pressure cylinder, said cylinders being in unobstructed communication at a point between said pistons, substantially as described.

817,609. Chuck for Rock Drills. Thomas E. Adams, Cleveland, Ohio, assignor to The Adams Drill Company, Cleveland, Ohio, a corporation of Ohio. Filed June 29, 1903. Serial No. 163,601.

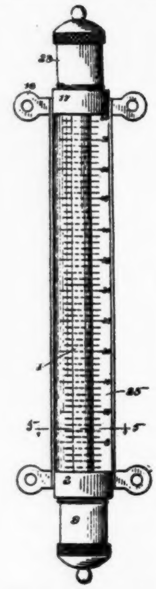
Claim.—1. A drill-chuck having a tapering exterior made with a continuous series of step-like ribs.

817,706. Air and Gas Engine. Allen O. Heney, Shakespeare, Ind. Filed Dec. 21, 1904. Serial No. 237,778.

Claim.—An air and gas engine, employing a cylinder having an inner piston-chamber opening into the intake end of said cylinder, and oppositely-moving pistons, said piston-chamber having a single inlet-port also communicating with said cylinder-intake end and delivering the gas and air charge, after initial compression, to the opposing action of the pistons, said inlet-port also adapted to be shut off by one of said pistons in its forward or compression movement, and said piston-cylinder also having a single exhaust-port adapted to be uncovered by the opposite piston, in its rearward movement, after the exploding of said charge, substantially as set forth.

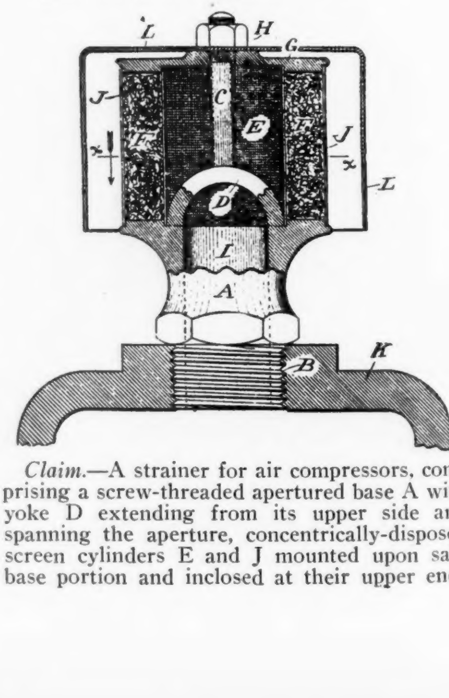
817,778. Air Pressure and Vacuity Indicator. Henry A. House, Bridgeport, Conn. Filed May 2, 1905. Serial No. 258,476.

Claim.—1. In an indicator of the character described, a glass tube, flexible reservoirs having open communication with the interior of said tube and at each end thereof, said reservoirs and tube sealed against the admission of air, a casing to form a chamber about each reservoir, one of said reservoirs holding liquid, means for admitting air above the normal



into one chamber to force the liquid into the glass, and means to permit the escape of air from the other chamber, for the purpose set forth.

817,797. Strainer for Air Compressor. William J. Ogan, Dayton, Ohio. Filed Feb. 1, 1906. Serial No. 298,908.



Claim.—A strainer for air compressors, comprising a screw-threaded apertured base A with yoke D extending from its upper side and spanning the aperture, concentrically-disposed screen cylinders E and J mounted upon said base portion and inclosed at their upper ends

by a cap G, a stem C projected from the yoke D and penetrating a central aperture in the cap, said stem being provided with a nut which tightens the cap against the screen cylinders, said screen cylinders providing a chamber concentric therewith and lying on the outer side of the aperture in the base, a filtering medium inclosed within said chamber, and a shield inclosing said strainer and held in position by the nut which tightens the cap against the screen cylinders.

817819. AIR BRUSH. Liberty Walkup, Rockford, Ill. Filed Aug. 18, 1905. Serial No. 274,803.

Claim.—1. In an air-brush, in combination, a tubular body threaded exteriorly throughout a portion of its length and provided with an inwardly-sloping perforated shoulder portion terminating in a neck, a conical plug having a tapering central bore extending longitudinally therethrough and tapped at its base into the free end of the neck of the tubular body, a conical cap having the interior of its larger end portion fitted closely to and slidable upon the unthreaded portion of the tubular body and the interior of its smaller end portion tapered to conform to but not contact the exterior of the conical plug, thereby forming an annular air-chamber between such cap and the neck of the tubular body and the conical plug and means for longitudinally adjusting the cap to the conical plug, substantially as and for the purpose specified.

817,953. FLUID PRESSURE BRAKE. Robert H. Blackall, Edgewood Park, Pa., assignor to The Westinghouse Air Brake Company, Pittsburg, Pa., a corporation of Pennsylvania. Filed June 13, 1903. Serial No. 161,296.

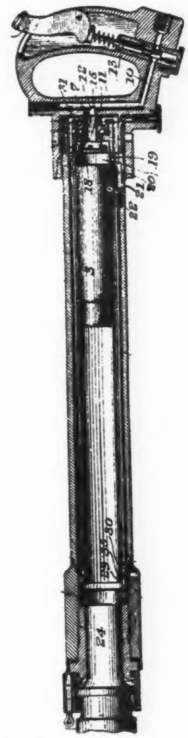
Claim.—1. In a fluid-pressure brake, the combination with a train-pipe, auxiliary reservoir, brake-cylinder, and a triple valve device having means for supplying air from the train-pipe and from the auxiliary reservoir to the brake-cylinder in emergency applications, of means independent of the triple-valve piston for slowly equalizing the pressure upon opposite sides thereof after an ordinary emergency application of the brakes.

818,060. PNEUMATIC WHEEL. Richard Thew and Hollis H. Harris, Lorain, Ohio. Filed Dec. 19, 1904. Serial No. 237,391.

Claim.—1. The combination of a sleeve adapted to surround the axle, an annular member mounted on said sleeve, a cushion on said annular member, a wheel having a hollow casing surrounding said cushion, a collar on the axle bearing against said sleeve and holding said annular member in place, and means for holding the collar in place.

818,037. STARTING MECHANISM FOR PNEUMATIC TOOLS. Robert T. Mickle, Philadelphia, Pa., assignor to Ridgely and Johnson Tool Company, a corporation of Illinois. Filed Sept. 6, 1901. Serial No. 74,529.

Claim.—1. In a pneumatic tool, a cylinder having exhaust ports, a piston therein, a normally open stop-valve contained in said cylinder,



and means for closing said stop-valve, and starting said piston when the working tool is pressed to the work.

818,155. AIR BRAKE COUPLING. John S. Farlow, Salisbury, Md. Filed Oct. 27, 1905. Serial No. 284,728.

Claim.—1. The combination with a car, of brackets secured thereto in spaced relation longitudinally of the car, a sleeve slidably engaged in the brackets and extending beyond the end of the car, a hollow resilient body carried by the outer end of the sleeve, said body having an opening in its outer portion and having another opening communicating with the passage of the sleeve, a collar carried by the sleeve between the bracket and arranged for engagement of the outer bracket to limit the outward movement of the sleeve, a spring disposed between the collar and the inner bracket to hold the sleeve yieldably against inward movement, a turn plug carried by the rearward end of the sleeve, means for automatically operating the turn plug when the sleeve is moved, a fluid supply pipe, and flexible connections between the turn plug and said supply pipe.

818,200. PNEUMATIC TYPEWRITER. Maximilian Soblik, Dusseldorf, Germany. Filed Nov. 16, 1903. Serial No. 181,292.

818,320. FLUID PRESSURE BRAKE AND OTHER APPARATUS. James N. Weikly, Jersey City, N. J., assignor to George Holt Fraser, Brooklyn, N. Y. Filed Dec. 10, 1896. Renewed Oct. 10, 1905. Serial No. 283,500.

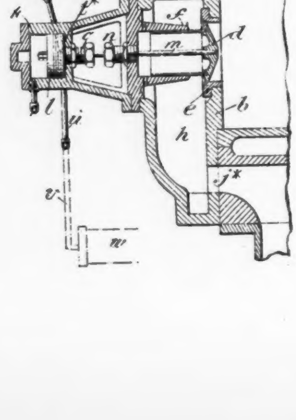
Claim.—1. In air brakes and other pressure apparatus, the combination with a source of fluid pressure, means for utilizing such pressure, a pipe communicating between said parts and a valve controlling such communication, of a pressure regulator in communication with said pipe beyond said valve and automatically preventing flow of pressure to said means exceeding a predetermined limit, and a valve operated by said regulator, having fully open and fully closed positions and popping from one position to the other without intermediate rest.

818,321. PNEUMATIC MATTRESS, CUSHIONS, &c. Richard A. Whall, Reading, Mass., assignor of one-half to Metropolitan Air Goods Company, Reading, Mass., a corporation of Massachusetts. Filed July 22, 1905. Serial No. 270,832.

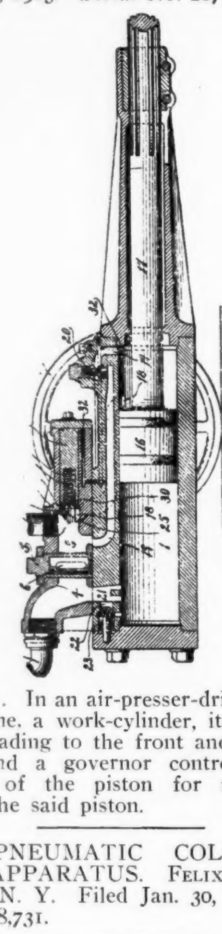
818,402. PNEUMATIC-TIRE PLUG. DAVID APSTEIN, Bridgeport, Conn. Filed June 24, 1905. Serial No. 266,863.

818,567. VALVE-OPERATING DEVICE FOR COMPRESSORS. HENRY C. SERGEANT, Westfield, N. J., assignor to Ingersoll-Rand Company, New York, N. Y., a Corporation of New Jersey. Filed June 26, 1902. Serial No. 113,342.

Claim.—1. The combination with the inlet-valve of a compressor, of a motor consisting of a cylinder and piston, means for admitting a pressure fluid to said cylinder on one side of the piston for closing said valve, and an elastic-fluid supply connected with said cylinder on the other side of said piston and exerting a constant tendency to open the valve, substantially as herein described.



818,619. COAL-CUTTING MACHINE. ARTHUR H. GIBSON, Easton, Pa., assignor to Ingersoll-Rand Company, New York, N. Y., a Corporation of New Jersey. Filed Nov. 15, 1905. Serial No. 287,401.

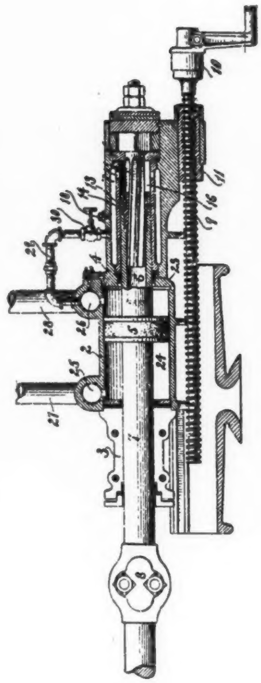


Claim.—1. In an air-presser-driven coal-cutting machine, a work-cylinder, its piston, air-passages leading to the front and rear of the cylinder and a governor controlled by the movement of the piston for reducing the stroke of the said piston.

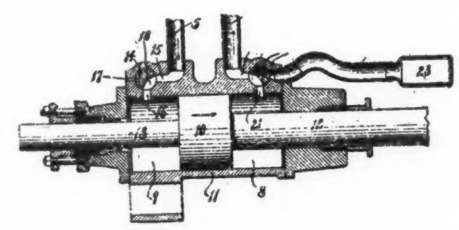
818,649. PNEUMATIC COLOR-APPLYING APPARATUS. FELIX WOLF, New York, N. Y. Filed Jan. 30, 1906. Serial No. 298,731.

818,681. ROCK-DRILL. ARTHUR H. GIBSON, Easton, Pa., assignor to the Ingersoll-Sergeant Drill Compan, New York, N. Y., a Corporation of West Virginia. Filed Aug. 26, 1905. Serial No. 275,851.

Claim.—1. A rock-drill piston having a tail-rod, a cylinder having a tail-rod chamber, and pipes for feeding the motive fluid to the opposite sides of the piston, said cylinder having a passage leading from one of the motive-fluid pipes to the tail-rod chamber.



819,011. ELECTROPNEUMATIC CHANNELER. Arthur H. Gibson, Easton Pa., assignor to Ingersoll-Rand Company, New York, N. Y., a Corporation of New Jersey. Filed Dec. 15, 1905. Serial No. 291,842.

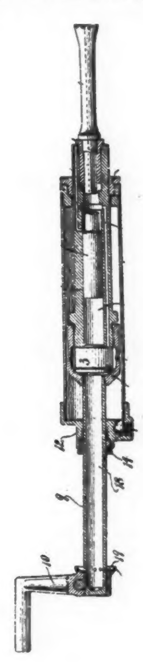


Claim.—1. A tool-piston, its cylinder, pipes for supplying motive fluid alternately to the opposite sides of the piston and means for closing communication between the space at one side of the piston and one of the pipes and opening the said space to atmosphere.

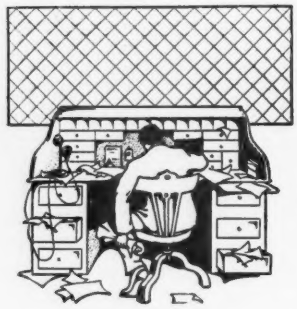
818,776. SAND-BLAST APPARATUS. John D. Murray, San Francisco, Cal. Filed May 5, 1905. Serial No. 258,965.

819,032. FLUID-PRESSURE BRAKE. William P. A. Macfarlane, Chicago, Ill. Filed Nov. 4, 1905. Serial No. 285,822.

818,638. HAMMER-DRILL. William Prellwitz, Phillipsburg, N. J., assignor to Ingersoll-Rand Company, New York, N. Y., a Corporation of New Jersey. Filed Dec. 7, 1905. Serial No. 290,690.



Claim.—1. In a hammer-drill, a hammer-cylinder and a hollow protective casing therefor having its walls entirely spaced from the cylinder, the cylinder being supported only by the ends of the casing for the purpose set forth.



Office CHIT-CHAT

¶ Most men—that is, real men—no matter what their regular vocation may be, are interested in knowing "how it's made", whether "it" be a toothpick or a magazine dealing with a technical subject.

¶ The why and wherefore of any product of the hand and brain of man is as interesting, in its way, to the user as to the maker. This applies in a marked degree to the man who pays for the product; and especially is it true in the relation between subscriber and publisher.

¶ We shall publish from time to time "Office Chit Chat" in the hope that our readers will use this page as a medium for expressing their commendations, suggestions and kicks to the end that COMPRESSED AIR may embody as far as possible the ideas of usefulness suggested by those who with ourselves, are most vitally interested in maintaining a clearing house of useful compressed air information.

¶ Perhaps you say "There are too many technical papers. I subscribe to two or three and while interested in pneumatics, I am not sufficiently benefited by receiving a waste basket full of papers every month." You are right—that is, half right. There are more technical papers published than can be properly digested, but there is no paper dealing with the subject of air under pressure except COMPRESSED AIR, an established paper entering its eleventh year.

¶ "I came like water and like wine I went," said Omar Khayam—and he *might* have said the technical papers come like water. They pour in—they stream in—papers devoted to civil engineering, mechanical engineering, electricity, water, gas, building, machinery, brewing, tanning, and so on, ad infinitum, good in their fields but in fields that look upon compressed air as an incident; and in most of these papers are continually appearing practical articles and paragraphs on compressed air.

¶ But how is the engineer, say at a mine power house, going to keep pace with compressed air?—By reading all the journals and clipping out the compressed air articles? If he did the mine wouldn't get much of his time.

¶ If he is up against a difficulty—a really tough one, what paper can he write to for help? He can write to any paper, but WHAT PAPER CAN ANSWER A DIFFICULT COMPRESSED AIR QUESTION?

¶ "Compressed Air Taught by Mail". Did you ever see a correspondence school "ad" that offered to teach compressed air by mail? No. They teach mechanical engineering, electrical engineering, law, acting, locomotive engineering, hydraulic engineering, and what not, by mail, but they side step compressed air.

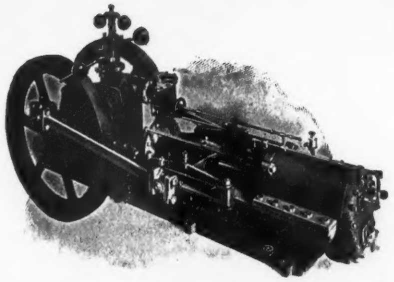
¶ Why?

¶ Because the men who KNOW anything about the subject are not teaching school. They are a comparative few and they are snapped up by the compressed air machinery manufacturers and set to work learning the practical side of the subject—which doesn't always coincide with theory.

¶ "Compressed Air" is edited by graduates of engineering schools who have served their time in overalls and worked and fussed and lived with air compressors, drills and pneumatic tools. They are theoretical men—who know when to cut out theory and substitute the knowledge gained by rough and tumble experience.

¶ "Compressed Air" takes from the hundreds of engineering and technical papers the matter pertaining to the subject, digests it and serves it up either straight or with remarks on the side—the information and clippings come to us like water—and like wine they go, concentrated, and in a selected form, with a clear and legible label.

¶ We don't know it all—and for this reason we are making a point of our correspondence columns so that we can swap ideas with the man on the job—so that we can answer a letter by printing it, even if it brings forth a storm of contradictory evidence. The more contradictions and disagreements the better for the man who runs a compressor or drill—for there can be but one "right" in an argument, and discussion and controversy will boil down the facts until the "right" is proved.



AIR COMPRESSORS

ALL STYLES—ALL SIZES

EMBODYING LATEST IMPROVEMENTS

ROCK DRILLS

McKIERNAN DRILL CO.

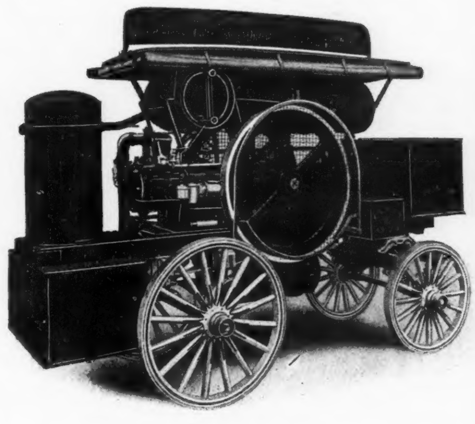
170 Broadway, New York City

House Cleaning Machinery

Stationary Private Plants for residences, **$350** and up. Power from lighting current.

Private Plants for Department Stores, Hotels, Theatres, etc.

Stationary Plants for Professional Carpet Clean ers.

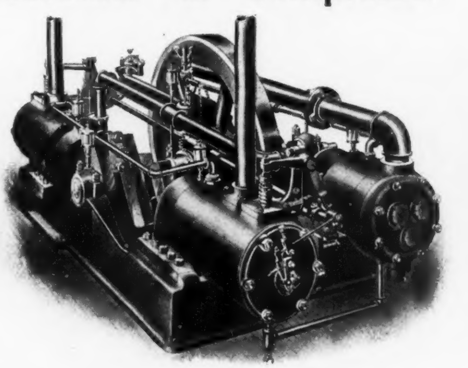


Portable Plants for residential house cleaning. Small capital required.

General Compressed Air House Cleaning Co.

4434 Olive Street, St. Louis, Mo.

Direct-Connected Gasoline Air Compressor



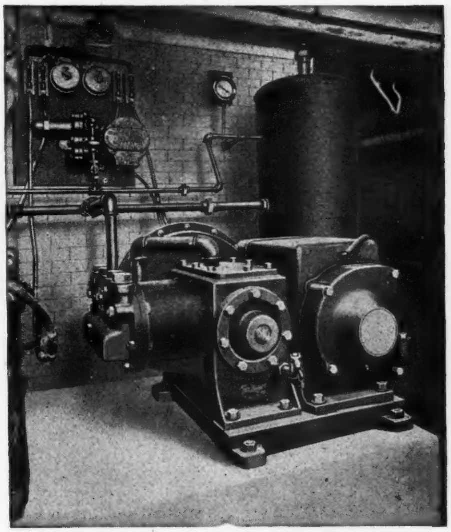
Single, double and four cylinder types.

Built in all capacities for all purposes. GEARLESS, COMPACT, ECONOMICAL and DURABLE. Furnishes its own power. The only machine of its kind.

We also manufacture electrical and belt-driven Air Compressors, Gas and Gasoline Engines, Spraying, Pumping and White Washing Machinery.

In asking prices and specifications on any class of machinery, please give full information as to requirements.

GENERAL ENGINEERING CO.,
4435 Olive Street, St. Louis, Mo.



Westinghouse Motor Driven Air Compressor, Operating Sewage System, Knickerbocker Trust Building, New York.

Westinghouse Air Compressors

Westinghouse Traction Brake Co.

General Offices : Pittsburg, Pa.

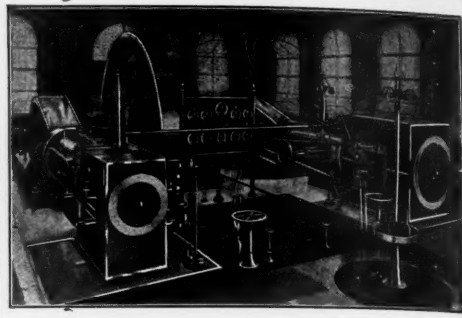
Address nearest office:

Boston, 638 Exchange Bldg.
Buffalo, 774 Ellicott Sq. Bldg.
Chicago, 1545 Ry. Exch. Bldg.
Cincinnati, 1111 Traction Bldg.
Cleveland, 1007 New Eng. Bldg.
Columbus, 1132 C. Sv. & Tr. Bldg
Denver, 604 Majestic Bldg.
Los Angeles, 527 So. Main St.
Mexico City, Mex., 4½ Calle de San Diego.
New York, 2014 Trinity Bldg.
Richmond, 804 American Nat. Bk. Bldg.
St. Louis, 1932 North Broadway.
St. Paul, 634 Endicott Bldg.
San Francisco, 302 Rialto Bldg.

For Canada, Canadian Westinghouse Co., Ltd., Hamilton, Ont.

INDEX OF ADVERTISERS

COOPER-CORLISS ENGINES



FOR ALL POWER PURPOSES

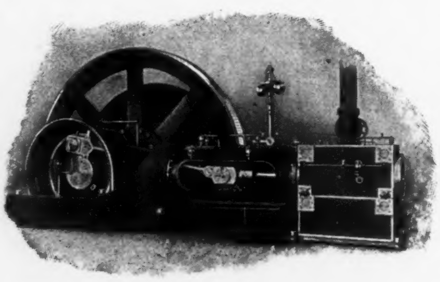
Complete Plants a Specialty

EXCELLENT FACILITIES FOR HANDLING EXPORT TRADE

ESTABLISHED 1833

The C. & G. COOPER COMPANY

MT. VERNON, OHIO, U. S. A.



NEW YORK, .	1430 Bowling Green Building
BOSTON, ...	411 Weld Building
PHILAPELPHIA	Drexel Building
PITTSBURG, . .	604 Frick Building
ATLANTA, ...	310 Chandler Building
CHARLOTTE, N. C. .	South Tryon Street

THE
ENGINEERING
MAGAZINE
AN INDUSTRIAL REVIEW